ENGINEERING NEWS.

Tribune Building. New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 3, 1881.

A CONNECTICUT court decided last week that a limited railway ticket is worthless except for the trip specified on its face.

WITH the first number of volume 5 (Dec. 1, 1881), the *Sanitary Engineer* announces that it will thereafter be issued weekly. For the present it will contain twenty pages, the subscription price remaining unchanged. We sincerely congratulate our esteemed contemporary upon its marked success.

MR. EDWIN CHADWICK, the Sanitary Engineer, makes an official report upon the sanitary condition of England and Wales, from which it appears that, according to the death rate, the country was stationary from 1860 to 1870, but from the latter date to 1880, or for the ten years past, the death rate has fallen from 22.5 to 21.5 per 1,000, a reduction of about 4½ per cent.

AN INTERESTING CASE TO CIVIL ENGINEERS.—On the 25th ult., in the Court in General Term, the case of Desmond against the Baltimore & Potomac Railroad Company was argued by Mr. Garnett for plaintiff and Totten for defendant. Desmond was discharged from the service of the company, but was not given a recommendation, as is customary with the usage of the craft, and failing to obtain employment he sued the company for damages. On trial below judgment was given for the railroad company on demurrer, and plaintiff appealed. Chief Justice Cartter delivered the opinion of the court, affirming the judgment below.—*Washington Star, Nov.* 25.

JUDGMENT has been rendered in the case of Molson's Bank vs. The St. Lawrence and Chicago Forwarding Company. The bank held a bill of lading for a cargo of wheat, which had been transferred to it as collateral for an advance for Bedall & Co., of Montreal. The wheat arrived in port and was delivered to Crane & Baird without a bill of lading. The bank sued the forwarding company, who claimed that they were not under contract, and that the bill of lading expired when the wheat reached the port of Kingston and was transferred to barges and forwarded to Montreal. The Court held that the bill of lading continued on till the latter port was reached, and that the company had no right to deliver the wheat without it. The company was condemned to pay the value, $16,275.

ON the 29th ult. Mayor Grace, of this city, vetoed a resolution of the Board of Aldermen authorizing the Metropolitan Telephone & Telegraph Company to lay their wires under the streets. His reasons are that the resolutions fail to make any provision for the payment to the city of any adequate consideration for the franchise sought; also that the payment of one cent per lineal foot of street occupied is scarcely more than nominal; only one wire in each route would be reserved for the use of the police and fire departments. A further objection is made that the petitioning company is only one of a large number who would claim the same right; and as the streets are now largely occupied by gas and water pipes, sewers, railroad foundations, etc., there would be no place, in many streets, for more than a few wires. It is further stated that such a privilege should only be granted after a careful consideration of the requirements of the entire telegraph system of the city, with a view to its future development.

MR. S. S. THOMPSON, the Superintendent of the Allentown, Pa., Water-Works, in complying with the request for statistics of his works for incorporation on "The History and Statistics of American Water-Works," which has been in course of publication in our columns since March last, adds that he has "sent a good many reports to different parties, but has never seen any published."

We have no doubt that the same feeling of uncertainty as to the publication of the statistics, which Mr. Thompson evidently felt, has deterred many officers of water-works from sending the data asked for. There are a good many blanks for statistics which have been sent out by Mr. Croes, with a stamped envelope inclosed for return postage, to which no reply has been received.

If this should meet the eye of any superintendent who has received such a document, we would suggest to him that he follow Mr. Thompson's example and send the blank filled out, and also all printed reports he may have to spare, to Mr. Croes, and we will promise that the information shall be published at once and made available to all water-works officers who take this paper.

THE FORTH BRIDGE.*

After much labor and study the engineers, Messrs. Fowler and Baker, and the consulting engineers, Messrs. Barlow and Harrison, a plan has been elaborated and determined upon for the Forth bridge, and although the writer in *Engineering*, from whom we quote, takes some pains to convince his readers, by illustrated reference to the works of savages and semi-savage people on a small scale, that the cantilever and girder principle, as well as the arch and suspension, were practiced in the early ages of civilization, if not in prehistoric times, and refers to a drawing by Lieut. Davis, R. N., made when on an embassy to an Oriental court, in 1800, and published then in London, as illustrative of the antiquity of this form of bridge, and adds, "making allowance for differences of material, the preceding work may fairly be looked upon as the prototype of the proposed Forth bridge," yet, notwithstanding all this, we must be permitted to regard the new Forth bridge as something novel in bridge architecture. To think otherwise would be equivalent to regarding our East River bridge as a very simple affair indeed. Does not the housemaid stretch her line between posts and hang her clothes on the catenary? and by no means unconscious of the increased strain brought on the line thereby. The whole principle of the suspension bridge indeed; but the scale upon which the modern engineer has ventured to utilize this principle gives his work the claim in reality, though not technically, of an invention. So of the new Forth bridge, a continuous trussed girder covering a space of 3,750 feet, in two spans, with trussed frames 350 feet in height over the pier, may well cause us to hold our breath in amazement.

As we regard it, in our simplicity, it would improve it possibly, as a design, if it were turned bottom upward. But in this we will yield to better judgment, and quote as follows:

A glance at the preceding illustrations and description will satisfy our readers that there is nothing novel or untried in the principle of the structure designed for the Forth crossing. It must be conceded, however, that except as regards principle the design is essentially novel, but the novelties are dictated by the unexampled size of the structure, and are due simply to the perfect adaptation of the principle of the continuous girder and the general laws regarding the strength of materials to the special conditions of the case. Thus it will be observed that the structure is a continuous girder of varying depth on plan as well as elevation, the central girder portion being of the ordinary width required for a double line of rails, and the cantilevers spreading out to an extreme width of 112 ft. at the piers. By this means the stresses on the horizontal bracing from wind pressure are much reduced, and lightness and compactness are attained. To further the same ends the whole of the vertical members are made of two struts inclined towards each other from base to summit and braced together. To reduce the extreme height of the structure, and bring the center of gravity as low down as possible, the bottom members of the continuous girder are curved, springing from solid masonry piers at a height of 18 ft. only above high water, whereas in the original design the main chains, carrying of course all the weight, were supported at a height of 550 feet above the same point! The main compression members are steel tubes ranging up to 12 ft. in diameter, the tubular form being adopted for two reasons; first, because experiments have shown that inch for inch the tubular form is stronger than any other, and, secondly, because the amount of stiffening and secondary bracing is thereby reduced to the lowest percentage. It might be thought that columns 350 ft. in length were an untried novelty, but this is not so, as we have the precedent of the Saltash bridge oval tubes 16 ft. 9 in. by 12 ft. 3 in. in diameter and 460 ft. in length, the strain upon which under the test load was higher per square inch than will be that on the steel columns of the Forth bridge. The central girder portion is simply an ordinary double-line railway bridge of 500 ft. span with girders of a type intermediate between the girder of parallel depth and the bowstring. This is an economical type, and many Continental bridges have been so constructed, among which may be mentioned the Kuilenburg bridge of 592 ft. span, the Bommel of 408 ft., and the fine bridge across the Waal near Nijmegen, which includes three spans of 426 ft. with main girders in less than one-sixth of the span, or 71 ft. in depth.

The chief desiderata in the Forth bridge, which is the largest railway bridge ever yet proposed to be built, are as follows:

1. The maximum attainable amount of rigidity, both vertically under the rolling load and laterally under wind pressure, so that the work when completed may by its freedom from vibration gain the confidence of the public, and enjoy the reputation of being not only the biggest and strongest, but also the stiffest bridge in the world.

2. Facility and security of erection, so that at any stage of erection the incomplete structure may be as secure against a hurricane as the finished bridge.

3. That no untried material be used in its construction, or, in other words, that no steel be employed which would not comply with the requirements of the Admiralty, Lloyd's, and the Underwriters' Registry, as determined by the experience gained in the use of many thousands of tons of steel plates, bars and angles for ship-building purposes.

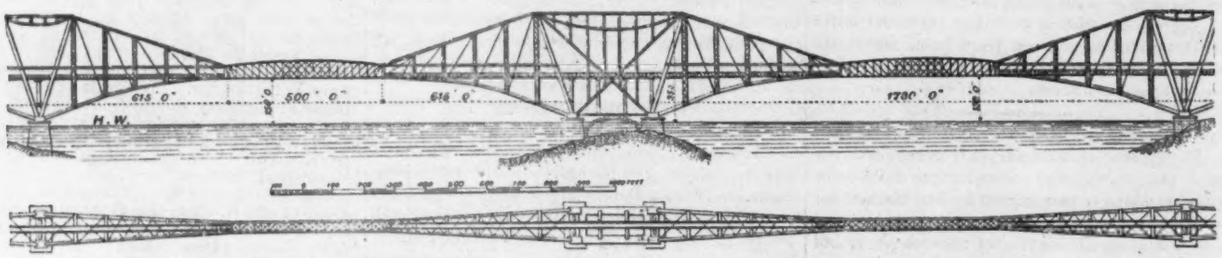
4. That the maximum economy be attained consistent with the fulfilment of the preceding conditions. We think it will be apparent to most engineers and bridge builders that the original suspension bridge design complied with none of these conditions, while the girder design complies with all.

As regards rigidity each span is calculated to carry a rolling load of 3,500 tons, and the deflection under the passage of an ordinary 400 tons goods train would be little more than an inch in the 1,730 ft. span, and should the wind ever blow with a force of 30 lbs. per square foot over the whole surface—a pressure probably sufficient to derail any train in motion—the lateral deflection would be the inappreciable amount of 6 in., or in other words the rails would be curved laterally to a radius of 140 miles. As regards erection the cantilever portion would be built by overhang, each successive bay being added and braced together vertically and horizontally with the permanent bracing as the work proceeds. Experience has amply proved that few contingencies attach to this mode of erection. One of the most recent examples is Mr. Shaler Smith's fine Minnehaha bridge across the Mississippi, having a center span of 324 ft., erected by overhang, and two side spans of 270 ft. with girders 30 ft. deep. No temporary works were used for the central span; but in arches, of course

* For the location and the specifications of this bridge, as designed by the late Sir Thomas Bouch, see page 24, vol. VII., ENGINEERING NEWS.

heavy and costly back ties have to be provided, and the difficulties in joining up the overhanging halves were found in the instance of the St. Louis and the Douro bridges to be not inconsiderable. In the Forth bridge these would not arise, and the details of the operations are of the simplest character.

As regards material, nothing but the highest quality of Bessemer or Siemens steel, as used for riveted work in shipbuilding, will be employed, and the strain will be limited to 6½ tons per square inch. It has already been stated that the continuous girder bridge proved on investigation to be the cheapest type of construction for the Forth bridge, and therefore it may be said that the whole of the desiderata are attained in that design. Of course the details are subject to modifications, as the borings and other preliminary works are still far from complete, and as already stated certain modifications suggested by Mr. Barlow and Mr. Harrison have been accepted by all parties. The matured design will, however, not differ in any essential point from that now illustrated. It will undoubtedly be a relief to engineers, contractors and railway companies alike to be finally quit of the suspension principle, and to have to deal only with the well-tried girder system. Experience has proved that whatever previous calculation may indicate, the amount of vibration pertaining to the suspension system is in practice



Deflection from 3,500 tons rolling load on each span...9 ins.
Lateral deflection with 30 lbs of wind.....6 ins.

Maximum strain on girder 6¼ tons per square inch.

THE FORTH BRIDGE.

always excessive. The antecedents of the latter type are not encouraging. Thus, the gatekeeper of the Menai suspension bridge stated that during the storm of Jan. 23, 1836, the undulatory motion of the platform at a point midway between the center and the pier was no less than 16 ft. In contrast with this, it may be mentioned that the maximum movement of the Britannia tubes during the heaviest gales, as observed by Mr. Edwin Clark, was only ¼ in. Whereas, as in the case of the Niagara bridge, the only railway suspension bridge in the world, although stiffening girders, inclined ties, and other arrangements are introduced to mitigate oscillation and wave motion, it is found that the combination is too lively to permit of the transit of high-speed traffic. A load limited to a single train, and a speed limited to a walking pace, necessitate a very different structure to a test load of 3,500 tons and a working speed of a Scotch express, especially when one structure crosses a sheltered inland gap and the other an exposed estuary. It will not fail to be observed by practical erectors that the girder bridge is made good by lateral bracing piece by piece as the work proceeds, while a suspension bridge would be swaying about in an imperfectly secure condition until the whole structure was complete. Great responsibility and anxiety must attach to the engineers and contractors of this gigantic work however carried out, and we feel sure that engineers generally, both in this country and abroad, will join with us in hoping that a great success may be achieved.

THE SEWERAGE OF AMERICAN CITIES AND TOWNS.*

We make no apology to our readers for filling a large space for several successive numbers in ENGINEERING NEWS by discussions on the subject of drainage and sewerage. The determination of the question of systems of sewerage, that are best applicable to the needs of cities, is too important to life and health not to demand our first attention, and we shall notice, as briefly as the importance of the subject will permit, such reports of engineers as come to hand, tending in any way to develop the true principles which should be our guide in this matter.

In a previous number of ENGINEERING NEWS we referred incidentally to the report of Mr. Latrobe as indicating a "one-sided view of the question of utilization of sewage." The report is able and exhaustive, and in general may be considered as representing the claims to public consideration of the rival systems of sewering cities very fairly, but is open to the objection that whatever merit or success has attended the operations for many years past of the "combined system" in many populous cities, both on this continent and in England, is made to give way to the successful working, during a limited period, of the separate system, but partially carried out in a single city of our own country. That the separate system is applicable to villages and towns of limited extent, and where the increase of population is neither uncertain in extent or direction, we admit; and the operation of the flushing tank at the head of all branch sewers, which is made an essential, as we understand it, in the separate system, is also admirable in such places; but its application in our northern climate, to large cities, with the habits of our people and the system of police, which appears inseparable to our government of large cities, renders it of more than questionable advantage in such localities; and the town of Lennox is cited in the report where the separate system is said to work well, but without flushing tanks, the roof water being admitted to the sewers and keeping them clean and pure. This is what we claim would be the effect of the combined system were it carried out with that attention to detail in construction and management, which the advocates of the separate system call for as necessary to success, and which they consider is but a small requirement in view of the great advantages otherwise offered by that system, and possibly this is so, but, unfortunately, daily experience shows us that such niceties as are necessary to its success are in practice utterly unattainable with us. As regards the earlier advocates of this system, we confess to having been in error. If Mr. John Philips claims to have been the originator and proposer of this system for adoption in London, we have not read him aright. He undoubtedly advocated the use of much smaller sections of sewers, as also pipes, at a time when the least dimensions of a sewer was what would admit men and barrows for the purpose of cleansing; and his evidence before the Metropolitan Sanitary Commissions in 1847-48, printed for Parliament, now before us, is a most admirable paper. From the formula for the discharge of running water, to the proper form and construction of sewers with their working, is so exhaustively considered that our present accumulated experience of 34 years adds nothing of value to the evidence there given. Even some of our modern inventions, notably the curvette, lately recommended for concentrating the dry-weather flow of large sewers, was not only suggested by him, but had been actually tried and found very satisfactory.

On page 49 he says: "that for the branch sewers, the smaller they are (provided they be large enough to receive and carry off storm waters in addition to the ordinary run) the better." On page 63 he states as follows:

"In laying out the drainage of an undrained town district, I would in the first place make a correct plan"—here he describes the operations preliminary, much as we now carry them out, in the combined system—"the lines of sewers all communicating with each other upon a uniform system of levels," and then proceeds to say: "The capacities I would then regulate (after providing for their extension to other districts, and for carrying off the back waters of the natural area), progressively from their head to their outfalls, and according to the number of houses, quantity of water, and area to be drained by each sewer, allowing them to be of sufficient capacity for receiving and carrying away rains and storm waters," not one word in his entire evidence before this commission, can be construed into advocacy of a *separate* system, although clearly so, for comparatively small sewers. Subsequent to this, in 1849, however, we find it stated that Mr. Philips prepared a plan for the drainage of London, in which he laid down the principles of new drainages on the "separate system," and finding, as an essential, "that at the main outlet a depôt should be formed, and works established, for raising the sewage, and connecting and distributing the same for agricultural purposes."

It will be perceived that the economic value of sewage formed an element in the system of drainage as proposed by Mr. Philips at that day, and whether the failure of any known method of utilizing city sewage modified his views or not, we are unable to say; but when the commission was appointed in 1856 to consider the plans offered for the main drainage of the metropolis, his plans did not come up for consideration. The report of this commission was made July 31, 1857, and was most extended in its scope, furnishing indeed matter for all subsequent inquiries in this direction, and we are not aware that anything since has been added to our stock of practical knowledge on draining and sewering of cities. There were one hundred and thirty-eight plans submitted to this commission, several of which embodied the principles of the separate system. Their report upon this branch of the subject will be found in our last issue (page 475), which set at rest the question of its applicability to London at least. But it is remarkable that if Mr. Philips or Mr. Rawlinson supported these views, neither of them should have appeared before the commission in advocacy of them. There were one hundred and sixty-three witnesses examined, either voluntarily or on call, and though Mr. Rawlinson appears in the list among the many professionals of the day, his

* Report to the Mayor and City Council upon a plan of Sewerage for Baltimore, Md., 1881, by C. H. Latrobe, C. E.
Report on the Sewerage and Drainage of the City of Stillwater, Minn., 1881, by D. W. Cunningham, C. E.
Report upon a System of Sewerage for the City of Elmira, N. Y., 1881.
Report to the City Council of the City of Quebec, by their Engineer, Chevalier C. Baillairge.

testimony has no reference to this branch of the subject, and his last publication, under the Public Health act of 1875, viz., "Suggestions as to Main Sewerage Works," which as an official document emanating from the Local Government Board, London, and from an engineer "beyond question foremost in his profession in England," may be taken as embodying the principles and practice of sewering as now practiced there.

(TO BE CONTINUED.)

CIVIL ENGINEERS IN THE NAVY.

Several changes in the personnel of the corps of civil engineers in the navy yard have recently taken place.

The four senior officers have been transferred to the "retired list," by reason of age, and four new appointments have been made to fill these vacancies.

The retiring civil engineers are: W. P. S. Sanger, a veteran of some 50 years continuous service in the navy, and since 1842 the civil engineer of the Bureau of Yards and Docks at the Navy Department; B. F. Chandler, whose appointment in the service dates back as far as 1852, late the civil engineer of the New London naval station; Norman Stratton, formerly of the New York navy yard, but on sick-leave for three years past; and Calvin Brown, an engineer well known on the Pacific coast, and civil engineer of the Mare Island navy yard for the past twelve years and more.

These officers have been retired from active service under the general retiring laws of the navy, in accordance with a late opinion of the Attorney General declaring the civil engineers of the navy to be regular naval officers, established by law as a staff corps of the navy, and entitled to retirement from active service upon reaching the age of 62 years, in the same manner as all other naval officers.

In anticipation of these retirements, and to secure the best qualified of the many applicants for the vacancies, the Secretary of the Navy under date of July 14,1881, issued general "Regulations governing the appointment of Civil Engineers in the U. S. Navy," restricting the age of candidates between 25 and 37 years, and requiring them to pass a satisfactory physical examination before a board of medical officers of the navy, and a satisfactory professional examination before a mixed board of line officers and civil engineers of the navy. Candidates were also required to present testimonials of good moral character, evidences of American citizenship, and of having pursued a course of civil engineering at some professional institution, and of having had at least two years practical experience as a civil engineer.

These examining Boards were convened at the Navy Yard, Washington, Aug. 10 last, when more than a score of candidates appeared for examination by permission of the Navy Department.

Several were found physically disqualified by the medical board, and the remainder entered upon the professional examination before the other board, consisting of Capt. Semmes, Commander Phythian, and civil engineers Menocal, White and Prindle.

This professional examination was wholly written and covered a period of ten days.

Several candidates fell out before its completion, and but nine were found to have passed a satisfactory examination.

These were arranged in the order of merit, and the first four were appointed and commissioned by the President, after confirmation by the Senate, at its late special session.

The successful candidates standing at the head of the list and securing the prizes, were:

1. Thomas McCollom, of Philadelphia, who was employed as assistant civil engineer at the League Island navy yard for several years, and latterly as acting civil engineer of the Pensacola navy yard, to which duty he was assigned last winter, at the urgent solicitation of the Navy Department, soon after his return from an extended tour of observation of more than a year in Europe. He is already well and favorably known in naval circles.

2. Christopher C. Wolcott, a graduate of West Point Military Academy in 1867, who resigns his commission of first lieutenant, 3d artillery, U. S. Army, to accept a higher one in the navy, and in a professional corps and duty much more to his liking. He is also a graduate of the Artillery School at Fortress Monroe, and has been engaged in connection with some scientific experiments under the Navy Department at the Washington navy yard. At the time of his appointment he was stationed with his battery at Fort Niagara, N. Y.

3. Frank O. Maxson, of Washington, who graduated at the head of the class in civil engineering of the Sheffield Scientific School at Yale College in 1872. After spending a year in teaching mathematics and natural sciences at the Norwich Free Academy, he pursued the post graduate course in civil engineering at Yale, where he also acted as instructor in surveying and mathematics, and in 1874 he became engaged upon the government surveys west of the 100th meridian under Captain Wheeler's corps of engineers, U. S. A., where he served continuously and with great acceptance until his present appointment in the navy.

4. Robert E. Peary, of Washington, who graduated at the head of his class in civil engineering at Bowdoin College, and has had some varied experience in railroad surveying and engineering.

These changes mark a new era in the history of this corps, as the combined result of long and patient effort to effect a supersedure of the old methods of favoritism and political influence in making appointments by a competitive professional examination, now for the first time introduced by the present Secretary of the Navy, Hon. Wm. H. Hunt, and to secure the benefit of their rights and privileges of rank and retirement, under the laws which have hitherto been only partially applied and enforced with regard to this corps of the navy.

The corps is also to be congratulated upon this new accession to its ranks, and the profession at large upon the recognition it receives in the final establishment of a staff corps of professional officers as resident engineers at our navy yards, in the immediate charge of the important public works of this branch of the government service.

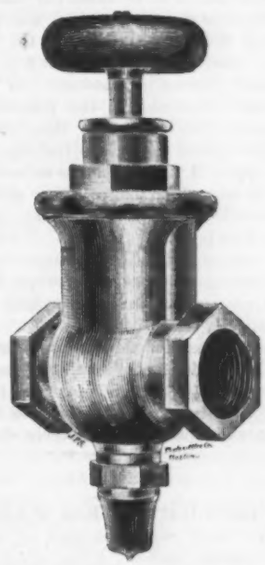
THE GEORGIA PACIFIC RAILWAY.

Last week we published an account of this road, together with a map showing its location; we now publish the following additional information which we have just received from reliable sources:

The entire line is under contract from Atlanta, Ga., to Oxford, Ala. (at which place it crosses the Selma, Rome & Dalton Railroad), a distance of one hundred miles. The contractors on this Division are: Wright & Co., Lee Brothers & Wright, C. R. Mason & Co., Perkins, Hutton & Perkins, John Kelly, and Leake & Dunn Bros. Of this one hundred miles thirty-four miles are graded. Track laying commenced at Atlanta on the the 18th ult. Twenty miles are graded eastward from Columbus, Miss., and track laying will commence at Columbus in a few days, the rails being now on the way. Thirty miles of road are in operation eastward from Greenville, Miss., with a branch of twelve miles in length extending southwardly into the Sun Flower country. No serious engineering difficulties are presented between Atlanta and the Mississippi River. There is not a tunnel on the route; the bridges are few and not costly. Surveys of the entire line are being made, and the location will be definitely fixed in a few weeks continuously from Atlanta, Ga., to Birmingham, Ala.

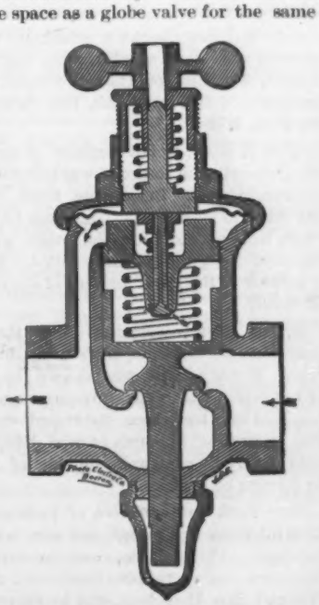
THE CURTIS PRESSURE REGULATOR.

A regulator of pressure should be simple in construction, durable, absolutely reliable, and should be free from any possible derangement of its working parts which would result in a failure to do its duty. It should be so constructed that when set the final or required pressure would be invariable,



no matter at what rate the liquid or gas was being used, and no matter how the initial pressure might vary.

The Curtis regulator, of which we herewith present a perspective and sectional view, contains a novel combination of old and established principles. It is made entirely of metal and occupies the same space as a globe valve for the same size



of pipe. It is a lock valve, is very simple in construction, sensitive in operation, and comparatively cheap. It has no glands nor packing, and the seat may be made of any material suitable for any liquid or gas.

The sectional view shows a main valve operated by a loose-fitting piston; a secondary valve in the

top of the chamber over the piston; a metallic diaphragm which performs the double office of operating the secondary valve and making a steam joint to the cap which contains it; and also a side passage connecting the chamber under the diaphragm with the outlet.

When the spring over the diaphragm is compressed, the diaphragm gives way, and thus opens the secondary valve upon which it rests. Steam from the boiler being left on, raises the piston, and therewith the main valve to its full capacity. The main valve remains open until the back pressure communicated from the outlet through the side passage is sufficient to raise the diaphragm, and thus close the secondary valve, when the steam, escaping around or through the loose-fitting piston, fills in the space on top of said piston, and forces it toward its seat, thus uniformly maintaining the pressure at which it is set. To make sure that enough steam passes the piston to produce the required pressure on the top of it, an adjustable set-screw is placed in the piston, which makes a very minute opening —a pin-hole—through the piston; this hole is always kept open.

The regulator is used on steam-heating apparatus, dryers, air-pumps, water-works systems, etc.; in fact, everywhere that gas or fluid needs to be automatically controlled.

The above-mentioned regulator is now being used upon the district steam-heating system of Lynn and Springfield, Mass., and also upon the system in this city. It is being manufactured by the Curtis Regulator Company, of 59 Beverly street, Boston.

PERSONAL.

It is stated that S. B. Reid, of Joliet, Ill., has been appointed Superintendent of Construction on the Canada Pacific.

Mr. Chas. A. Waller, late Commissioner of Public Works in Chicago, is spoken of as Superintendent of the public improvements at Pullman, Ill.

The beautiful masonry work one sees about Bath, N. Y., on the line of the New York, Lackawanna & Western R. R., has been done by Mr. W. R. Page, of Montrose, Pa.

Col. William Crooks, a prominent railroad contractor, and state senator, was married to Miss Hattie, daughter of Thomas Shields, Esq., at the residence of the latter, No. 153½ Wabash avenue, St. Paul, Minn.

Wm. J. King, a civil engineer in the employ of the Pennsylvania Railroad, was killed near Gallitzin on Tuesday last. In stepping from one track to the other to let a freight train pass he failed to notice a train approaching the other way and was knocked down and instantly killed. Mr. King was a nephew of the late President of the road, Thomas A. Scott.

It has been ascertained that the fire at the American Rubber Company's works, in Cambridge, Mass., Monday night, was caused by the friction of the belts, which set fire to rags and other material that had been saturated with benzine. The insurance amounts to over $200,000, and is held mostly by companies outside of Boston and by foreign companies.

New York has one acre of park area to every 1,142 inhabitants; Chicago, one acre to every 252 inhabitants; Philadelphia, one to every 282; St. Louis, one to every 166; Baltimore, one to every 433; and San Francisco, one to every 198 inhabitants. New York has 1,250,000 inhabitants, and a park area of 1,094 acres; Paris has 2,000,000 inhabitants, and a park area of 8,000 acres; London has 4,000,000 population, and a park area of 15,000 acres.

Sir E. J. Reed, a distinguished English engineer, is expected to visit the city to-day on his return from the South. It is stated that one of the objects of his visit is to examine into the Huron & Ontario Ship Canal Scheme, and the new lift-lock which is associated with it. Sir E. J. Reed's name is well known in connection with the construction of ironclads for the British and Russian navies, as well as for many other important engineering works. It is rumored that a reception will be tendered him during his stay in Toronto.—*Globe, Nov.* 30.

Jas. P. Weller, a civil engineer, of Wilkesbarre, Pa., was to be married to Miss Bessie Norris, on the 22d ult. Everything was arranged for the ceremony, when a note from Weller informed the prospecting bride that her lover had run away. Miss Norris is lying in a critical condition, and fears as to her recovery are entertained. Weller repented and returned in two days, and notwithstanding some family opposition it is expected the marriage will yet take place.

We take much pleasure in announcing that George O. Manchester has been elected General Manager of the Leavenworth, Topeka & Southwestern Railroad, with headquarters at Topeka. Mr. Manchester is well-known throughout Kansas and all over the country as the Assistant General Manager of the Atchison, Topeka & Santa Fe, a position which he has filled with signal credit. He will bring to his new work a valuable experience, and a reputation second to that of no man of his age in the railroad business. A better selection could not have been made, either in respect of capacity or for the satisfaction of the public. The new road will be a popular road, we are quite sure; and the owners and directors are to be congratulated upon their good luck in securing a man so admirably adapted to the management of their enterprise. Mr. Manchester assumed his new position Dec. 1, and it is expected that the road will be in operation to Topeka by the 1st of March. —*Topeka Capital, Nov.* 24.

Mr. A. M. Wellington, Chief Engineer of the New American line of railway between Vera Cruz and the City of Mexico, and engineer in charge of location surveys of the Palmer-Sullivan railroads of Mexico, arrived in New Orleans on the 19th ult., and on the 26th favored us with a call. Mr. Wellington thinks that Mexico is a "land of promise;" it is in a very undeveloped condition at present, but it is bound to become a very rich and prosperous country. The climate, excepting a thin strip on the Gulf Coast, is more than fine; it is perfectly delightful, and very healthy. Living in the City of Mexico is expensive; more so than in this city, but elsewhere in the Republic it is about the same as in the United States. Mr. Wellington will need the services of nearly thirty well qualified civil engineers of all grades inside of the next three months. He left for Cleveland and Chicago on the evening of the 26th, and will leave New Orleans for Mexico on the 16th inst. Mr. Wellington would promise nothing regarding his very popular rule on the "economic location of railways," and the prospects of a new edition for at least a year to come are very poor indeed.

The ruling spirit of the Canada Pacific Railway syndicate is Duncan McIntyre, Esq. Four years ago he was a wholesale dry goods merchant, doing a fairly profitable business in the thriving city of Montreal. A zealous and active partisan in politics on the reform side, he won the personal friendship of Mr. McKenzie, the Canadian Premier, and through his recommendation was induced to join with an experienced railway contractor in completing the extension of the Canada Central Railway from Pembroke to Callender Station, where the connection with the Canada Pacific is to be made. The Canada Central Railway was a bankrupt concern, managed by the great English iron firm, Messrs. Bolckow, Vaughn, & Co., who held nearly all the stock in payment for the equipment of the road. Through his brother Robert, formerly a member of the Canadian Parliament, but now a retired capitalist living in England, Mr. McIntyre bought one million dollars worth of Canada Central stock at twenty-five cents on the dollar, and thus virtually controlled the Eastern terminus of the Canada Pacific Railway by his ownership of the whole of the Canada Central. When the syndicate was formed by Messrs. Stephen, Smith, Angus and Hill, Mr. McIntyre became a necessity. He joined forces with the others and his road was soon merged into the Canada Pacific, of which it is now called the Eastern Division. Mr. McIntyre is probably the most active member of the syndicate, being ever "on the wing," and giving to every detail of the immense interest that he is a partner in his constant and closest attention. He is reputed to have already made a profit of a million of dollars, which probably is not an over-estimate. He is a clear-headed man, of iron will, of untiring energy, of arbitrary methods in business, who has recognized "the tide in men's affairs" that has taken him upon its crest and will bear him onward to a height which only the future can measure.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 469.)

CXLVIII.—PEORIA.

Peoria, Illinois, in lat. 40° 37′ N., long. 89° 42′ W., on the west bank of the Illinois River, is on high ground surrounded by bluffs. A trading post was established at this point in 1680 by the French. The permanent settlement began in 1819.

Water-works were built by the city in 1869, taking water from the Illinois River and pumping directly into the mains by Holly rotary pumps. A Cameron pump of 1,750,000 gallons capacity was added shortly afterwards to supply the bluffs. In 1875 a 2,250,000 gallon Dean pump was put in as an auxiliary to the supply. In 1880 two Worthington pumps of 5,000,000 gallons capacity were erected and the Holly engine removed. The pressure is 60 lbs. per square inch for domestic service and 140 lbs. for fire service. Distribution is by cast-iron pipe, of which 43 miles are in use, of from 16 in. to 4 in. diameter, with 267 fire hydrants, 1,645 taps, 6 meters and 7 hydraulic elevators.

The population in 1880 was 29,815 and the daily consumption 2,000,000 gallons.

The works have cost $450,000. The bonded debt is $450,000, bearing from 10 to 6 per cent. interest. The expenditures in 1880 were: For maintenance and repairs, $18,988.73; for extensions, $15,130, and for interest, $32,897.91. The receipts from water rents were $24,805.14. The superintendent of the works reports to the Common Council. T. J. Kelly is the Superintendent and Henry H. Forsyth the City Clerk.

CXLIX.—BLOOMINGTON, ILL.

Bloomington, Illinois, in lat. 40°, 40′ N., long. 89° W., is on an undulating prairie. It was settled in 1831 and incorporated as a city in 1850. Water-works were built by the city in 1875, after the plans of Henry P. M. Birkinbine, C. E., and under the superintendence of Ira Merchant, C. E. Water is taken from a well sunk through soil and clay into water-bearing gravel. The ground where the well was dug is 68 ft. below the highest point in the city. The well is 40 ft. in diameter for 28.5 ft. from the surface, and an 18-in. pipe is sunk 10 ft. more. The water stood in the well the first year, 5 ft. below the surface of the ground.

A Worthington pump of 1,000,000 gallons capacity was erected in 1875, and a Blake pump of

* Copyright 1881.

2,000,000 gallons capacity in 1881. The engines deliver into a 10-in. main leading 1,000 ft. to a stand-pipe of wrought iron, 8 ft. in diameter and 200 ft. high on ground 35 ft. above the engine-house floor. It is inclosed in an octagonal brick tower.

Distribution is by cast-iron pipe of from 10 to 4 in. in diameter, of which 12½ miles are in use, with 150 fire hydrants, 40 gates and 475 taps.

The population in 1880 was 17,184 and the daily consumption 400,000 gallons. The works have cost $122,000 and the receipts to date have been $27,267. The bonded debt is $75,000 at 8 per cent. interest. The interest is paid out of the city taxes. The expenses in 1880 were $5,426.60, and the receipts $7,613.91. The works are managed by a board of three members of the City Council, with the City Clerk as clerk to the Board. M. X. Chuse, has been the superintendent since the beginning.

CL.—JACKSON, MICH.

Jackson, Michigan, in lat. 42° 15′ N., long. 84° 20′ W., is on both sides of the Grand River. Settled in 1829, it was incorporated as a village in 1843 and as a city in 1857. Water-works were built in 1870 by a private company, and purchased by the city in the following year. The supply is taken from two artesian wells, 6 in. in diameter and 203 ft. deep. Another 10-in. well is now being bored; 1,500,000 gallons have been pumped from the wells in 24 hours.

Water is pumped directly into the mains by Holly pumps. Two rotary pumps were first used. In 1872 two piston pumps of 10 in. diameter and 27-in. stroke were added. A domestic pressure of 50 lbs. per square inch is maintained. The fire pressure is 120 lbs. Distribution is by cast-iron pipe of from 15 to 4-in. diameter. Thirteen miles are in use, with 76 fire hydrants, 35 gates, 182 taps and 4 meters.

The population in 1880 was 16,105, and the daily consumption 800,000 gallons.

The works cost $180,000. The bonded debt is $140,000, bearing interest at 8 per cent., and $23,500 at 10 per cent. The expenditures in 1880, not including interest, were $7,008.90, and the receipts $8,250.92.

Soon after the construction of the works some difficulty was experienced from the freezing of pipes, which had not been laid deep enough.

The works are managed by the Superintendent, John Anderson.

CLI.—RACINE.

Racine, Wisconsin, in lat. 42° 44′ N., long. 87° 47′ W., is on the west shore of Lake Michigan, at the mouth of Root River. The city is on a plateau about 40 ft. above the level of the lake. Settled in 1835, it was incorporated as a city in 1848. About 1870 an artesian well was bored 1,300 ft. by a private company, from which a supply was furnished to one ward of the city. About 1878 another well was bored by the city. The yield of each well is about 550,000 gallons per day.

The distribution was at first by wrought-iron and cement pipe. The distribution of the well owned by the city is by cast-iron pipe, and the company is also substituting cast-iron mains and lead service pipes for the kind at first used. The pipes are of 6-in. and 4-in. diameter. The length of the mains is not furnished.

There are 4 fire hydrants, 5 gates and 200 taps. No meters are used. The entire works have cost $14,000.

The population in 1880 was 16,031. The consumption is not stated. H. Raymond is the Superintendent of the Artesian Well Company.

CLII.—ALLENTOWN.

Allentown, Pennsylvania, in lat. 40° 36′ 24″ N., long. 75° 28′ 34″ W., is on high ground on the west bank of the Lehigh River, between the Little Lehigh on the north and Jordan Creek on the south. The streets leading into the city from the three rivers are all of steep gradients.

The town was settled in 1762, incorporated as a borough on March 18, 1811, and as a city on March 12, 1867.

The Northampton Water Company was incorporated in 1816, for the purpose of supplying water; but no active steps were taken towards that end until 1827. In 1833 the property of the company was valued at $18,000. Water was taken from Worman's Springs, which yield 2,500,000 gallons per day. The company was reorganized some years later as the Allentown Water Company, and in 1865 the works were purchased by the city for $140,000.

A timber dam 6 ft. high across the Lehigh River gives a water power, which drives two turbine wheels, which work piston pumps, forcing the water, which is brought from the spring, through 2,300 ft. of 12-in. pipe to the pump well into a stand-pipe 6 ft. in diameter and 55 ft high, and two covered reservoirs, one 48 by 29 ft. and 13 ft. deep, the other 96 by 32 ft. and 12 ft. deep, holding 410,242 gallons.

Distribution is by cast-iron pipe of from 16-in. to 2-in. diameter, of which 18 miles are in use, with 95 fire hydrants, 2,400 taps and 18 meters. During the summers of 1879 and 1880 low water in the river caused serious apprehensions and some deficiency in the supply on account of lack of pumping power.

The population in 1880 was 18,063 and the daily consumption 1,000,000 gallons.

The works have cost $189,054.76. The bonded debt is $135,622. The first bonds bore 7 per cent. interest. Those of this issue, falling due in 1879–1880, were refunded at 6 and 5 per cent interest.

The receipts and expenses since 1875 (except 1878, which are not furnished), have been as follows:

	1876.	1877.	1879.	1880.
Expended for interest.....	$9,589.53	$9,642.74	$8,823.01	$11,259.99
Expended for maintenance, etc.....	5,777.96	2,905.38	5,086.33	3,403.68
Receipts.....	20,202.96	16,804.08	15,486 30	16,439.75

The works are managed by a board of four water commissioners appointed by the councils.

Russell A. Thayer was superintendent to 1879. Samuel S. Thompson is the present superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks. From Samuel W. Waddle, City Clerk, statistics and water rates of Bloomington, Ill., Water-works. From John Anderson, Superintendent, statistics and water rates of Jackson, Mich., Water-works. From H. Raymond, Superintendent, statistics of Racine, Wis., Artesian Well Company. From W. O. Munson, Secretary, reports of Trustees of Zanesville, O., Water-works for 1874–'5–'6–'7–'9–'80. From H. H. Forsyth, City Clerk, statistics of Peoria, Ill., Water-works, and reports of city officers for 1871 and 1880. From J. Nelson Tubbs, Chief Engineer, report of Rochester, N. Y., Executive Board, April, 1881. From Frank Doherty, Superintendent, report of Trustees of Columbus, O., Water-works, March 31, 1881. From Samuel S. Thompson, Superintendent, statistics of Allentown, Penna., Water-works and reports for 1876–'7–'9–'80.

Speaking of the enlarged Welland Canal, the *St. Catharines Journal* says: "So complicated is the machinery of the locks that it is thought unsafe to go through except under the immediate supervision of an experienced engineer. Outsiders and vessel men are not able to elucidate the mysteries connected with the enlarged Welland Canal, through which vessels are only allowed to pass, it seems, by special favor. Only two vessels have been permitted to lock up and one down, so far. Practically the canal is not yet open for a twelve-foot navigation. When it will be seems to be known only to the chief engineer. The scheme of canal enlargement cannot be fully realized until the aqueduct at Welland is built, a work not even under contract, although it is one which will require two or three years to complete."

CORRESPONDENCE.

TOTAL CURVATURE OF ANY LENGTH OF CURVE.

CAMP DEEP CREEK, Nev., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I notice in your issue of Oct. 15 Mr. Hollingsworth's article regarding method of ascertaining total curvature for any length of curve. I suppose that Mr. Hollingsworth's idea is that you are to cut his table of multipliers out and paste it in your hat.

I give you the following method as being, in my judgment, very much simpler: Divide the total number of minutes in the index degree by 100, which gives the curvature for one foot; then multiply this quotient by the number of feet in the curve and you have the total curvature expressed in minutes. For example, to find total curvature of a 3° 20′ curve of 1,279 ft. length: 3° 20′ = 200′ ÷ 100 = 2′ × 1,279 = 2,558′ ÷ 60 = 42° 38′ = total curvature.

F. C. HAND.

THE DISEASE OF NEW YORK AND ITS REMEDY.

NEWPORT, R. I., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I have carefully read your editorial review of my letter of Nov. 15, and beg space for a reply.

Let me first state that I have not so much objected against the views entertained by "W." in his communication, "The Disease of New York and its Remedy," as against the tone of the article. As a constant reader of ENGINEERING NEWS, I would have much preferred to find in its columns an impartial criticism on the "separate system of sewerage." The article of "W." may do very well for a daily paper, but personal controversies do not, in my opinion, belong to the columns of an engineering journal.

As I understand the article of "W.," it condemns the principle of the system proposed for the city of New York by the writer of the *Scribner* article. And just here I dissent from his views. While I do not believe that the separate system is adapted for New York City, nor that one method of removing human excreta, etc., from inhabited localities can be applied with equal success to all cases; and furthermore, while I do not think that the existing condition of the sewers of New York is "unavoidable in all works of combined sewerage," I do believe that there are many instances in which the separate system may be adopted with advantage.

Reference to the *Sanitary Engineer*, vol. 3, p. 379, will show that my opinion in regard to sewers of both systems was expressed as follows: "Both may be so planned and constructed as to insure the instant removal of all liquid and solid excreta with sufficient velocity to prevent deposits (in either case, if necessary, flushing arrangements may be provided)." I see no reason for deviating from my opinion now. As an instance of a successful system of "combined" sewerage I would cite the sewers of Franfort-on-Main, designed and built by William Lindley, Esq., C. E., which are pronounced, by all who have carefully examined them, model sewers in every respect, and probably as free from sewer gas as the sewers of Memphis are said to be.

But when you say "that the intelligent engineer who advocates the separate system for populous cities lays himself open at least to suspicion as to his motives, in view of the present condition of the sewerage question in this country," I beg to differ from your opinion. Mr. C. H. Latrobe, C. E., who in his recent report upon the sewerage of Baltimore recommends the separate system for that certainly "populous" city, could have no other motive in advocating the system than the desire to benefit the citizens of Baltimore with his

experience and views on the subject, to which he devoted a long and thorough study.

I am willing to admit that Mr. Latrobe's view, as quoted by you, that the city will derive a considerable revenue from utilizing its sewage, may be too sanguine, as present experience does not seem to justify the expectation of much profit from sewage utilization.

But it would seem to me to be equally wrong to condemn entirely, on this account, the purification of sewage by irrigation or similar methods. I think that there are many cases, not only in the old country, but also in the United States, where cities should carry out sewage purification works, even if they would realize no profit whatever from them. The loss from running these works should simply be charged to city expenditures in the interest of the public health. There are, in my opinion, cases where cities must adopt some method of purification in order to keep their rivers pure, such as, for instance, Milwaukee, Paterson, Newark, Worcester, etc.

In all these instances, but especially so where pumping must be resorted to, the separate system is, I think, entitled to great consideration.

When I said that the separate system of sewerage was first introduced into this country by the writer of the *Scribner* article, I did not intend to convey the idea that the engineering profession had hitherto no knowledge of such a system. I only meant that he was the first to carry out sewerage works according to that plan in a city of the United States. If you can name me any other city where sewers for house refuse only were built previous to those at Memphis, I shall certainly acknowledge my mistake.

I note the report of the Committee on the Metropolis (London). But I fail to see why, if in 1856 the separate system was condemned as impracticable for a metropolis, it should follow that it is equally inapplicable to other cities not as populous as London. As a matter of fact, since 1856 a number of opinions, entitled to the highest consideration, have been very favorable to the separate system.

Your remark about the works and writings of the author of the *Scribner* article I disregard entirely. I, for one, certainly differ from your opinion in this respect.

I admit that, as a general rule, the plumber's work ranks with that of a handy craftsman, and that the occupation of plumbing should not be called a "profession." This was merely a *lapsus calami;* it does not, however, in the least affect what I have said about plumbers and their work.

Referring to your illustration of the needless alarm kept up about the filthiness of the pan-closet, I will say that, to my knowledge, every sanitary engineer, whose experience through examination of the sanitary condition of city dwellings has led him to give the subject of water-closets careful onsideration, agrees with the writer of the *Scribner* article about the utter worthlessness of the "pan-closet." I am fully aware that its most glaring defects can be modified by special devices, such as a fresh air pipe and a vent pipe to the container, flushing arrangement for pan and container, etc. But I hope that you will agree with me that, with the amount of extra expense necessary to make the pan-closet fairly acceptable, a better water-closet can be bought.

My opinion about the unfitness of the pan-closet is not at all changed by the fact that 600,000 persons in New York use no other, nor do I believe that one person in a thousand in that city has informed himself about the usual condition of the hidden parts of the closet. But those few that have given the matter consideration acknowledge its defects, and begin to ask for improved devices. Whoever can afford to pay for a better substitute will never use the pan closet. Its cheapness is its only merit, and this is the only reason why it is so largely used. Space does not permit me to give in full the opinions of sanitary engineers about the pan-closet.

I will briefly quote from Mr. Philbrick's "American Sanitary Engineering," page 118: "Though so popular and almost universally used in this country, *the pan-closet is a very defective one, and often becomes a great nuisance in houses* (the italics are mine).

Mr. Jas. C. Bayles says in "House Drainage and Water Service:" "Closets of this pattern are defective in principle and unsatisfactory in operation; and although they have been variously modified and improved during the past years, it is doubtful if they are susceptible of such improvements as will wholly correct their inherent defects."

Mr. Hellyer, a practical plumber and manufacturer of plumbing goods, says in his "Plumber and Sanitary Houses:" "The writer has always been puzzled to understand how this apparatus has become so great a favorite with the public and been to extensively used by the craft. The only bliss that the public can have about so foul a thing is 'ignorance' of its nature, but what excuse to make for the plumber I know not, except that it was the custom of their fathers to fix a pan-closet and this has become a law with them."

Your illustration, showing the higher salubrity of a city house with a pan-closet, as compared with life in a country village, without sewers or modern conveniences in the houses, is, I believe, not well taken. There are other and certainly just as serious defects in a country village without sewerage, which may account for the appearance of zymotic diseases; for instance, the almost universal leaching privy vault in close proximity to shallow wells, from which the water supply is taken, and that to these a large amount of *preventable* sickness in the country is due, nobody will deny who has read the numerous Board of Health reports.

Thanking you for the privilege offered me of space in your columns for a reply,

I am yours, very respectfully,

WM. PAUL GERHARD.
Civil and Sanitary Engineer.

[We gladly give place to the above well-written article.

Admit that "W.'s" article would appear better in a daily paper.

Are pleased to find agreement between us as to the inapplicability of *one* system to all circumstances and localities.

Regret that Mr. G. should see in a remark bearing upon the possible motive of "intelligent" engineers reference solely to *pecuniary* motives. The Temple of Ephesus, we are told, was burned by a worthy who sought by that means "immortality."

Agree with him substantially in what he says as to irrigation works and pumping sewage. He is correct, we believe, as to the city of Memphis being the first *city* to introduce separate sewers.

He is equally sound as to the principle of the pan-closet not being the *best* in the market, possibly, but is in error when he assumes that a reasonably economical machine, such as only the masses can afford, can be devised, which will not in use become open to objections from a "theoretical" sanitarian

We recognize Mr. Philbrick as good authority on this subject, as also Mr. Bayles to a certain extent, but we hesitate to accept on general principles the opinion of any manufacture of "plumbing goods," on such a subject as the selection of a proper closet. Mr. G. is also correct in his general views as to the possible prevalence of preventable disease, and the causes which may lead to it in country places; but we may fairly conclude that this pan machine is not so very deadly as reported, if immunity from disease, after long years of its use in the city, should prove more clearly marked than when the surroundings were those of a country home, and which, so far as human sagacity could be a guide, was free from the influence of any of these sources of contamination, mechanical or otherwise, likely to appear in country places. —ED. ENG. NEWS.]

PLANS FOR THE NEW TAY BRIDGE.

The plans of the proposed new Tay bridge, prepared by Mr. W. H. Barlow, C. E., are now on exhibition in Edinburgh, for inspection by intending contractors. The new bridge, says the London *Times*, which is to be built on the girder principle, will commence on the south side, about 16 ft. west of the former bridge. At this end four brick arches are shown next the shore, each having a span of 50 ft. The girder work then commences with a span of 118 ft. from center to center of the piers, and is continued with 10 spans of 129 ft., and 13 of 145 ft. from center to center of the piers, until navigable portions of the channel are reached. Here there are 13 wider spans, 11 being each 245 ft. and two 227 ft. each. Of these spans the first four are carried to the greatest height of the structure, and give 77 ft. of clear headway above high-water mark. From this point the line of the bridge commences to fall toward the north or Dundee side, at a gradient of one in 114, there being one span of 162 ft., ten of 129 ft. 6 in., and one of 127 ft. 6 in. These spans carry the bridge on to the commencement of the curve toward Dundee, and 25 more, each of 71 ft., take the structure to the side of the proposed extension of the esplanade. Several other spans take the bridge on to the point where it is run into the level of the existing arches. The bridge is to be constructed for a double line of rails throughout.

The foundations in the river bed will be formed of two wrought-iron cylinders placed at a distance of 26 ft. apart from center to center, and filled with concrete. These cylinders rise to the height of within 2 ft. of low-water mark, where brick will be used, filled in also with concrete. The brick-work is to the height of 3 ft. above high-water mark, at which level the cylinders are connected and made to form a solid foundation, topped with a course of ashlar. Rising from this foundation two piers are formed of wrought-iron pillars braced together and incased with iron plates of from $\frac{3}{8}$ to $\frac{7}{16}$ in. in thickness. The piers thus constructed are connected with each other near the top, and the whole has the appearance of a high and strongly built arch on which to place the girders. The principal piers are octagonal in shape, with a diameter varying from 11 ft. to 14 ft. 6 in. The spans are each composed of four girders, with the exception of the higher spans. These are two girders connected together, top and bottom, with bracing and flooring. The bridge throughout its whole length will have a parapet of between 5 ft. and 6 ft. in height, forming a wind guard. The depth of each girder on the piers is 16 ft. 6 in The middle girders are 28 ft. 9 in. in the center and at the ends 20 ft. 3 in. They are of hog-back lattice form. The other girders are of plain lattice work, and are all connected by cross-bracing, on the top of which the train travels, as it did on the old bridge. At the high girders the train travels between them. The platform of the bridge is of wrought iron throughout. In the construction of the new bridge, the old one will be sufficiently near for anchorage and cranes.

THE MISSISSIPPI AND TRIBUTARIES.

A pamphlet on the Mississippi and its tributaries gives the following statement of the mileage of the navigable portion of each of the following-named rivers above its mouth; Missouri, 3,120; Mississippi, 2,161; Ohio, 1,021; Red, 987; Arkansas, 884; White, 779; Tennessee, 789; Cumberland, 900; Yellowstone, 474; Ouachita, 384; Wabash, 365; Alleghany, 325; Osage, 363; Minnesota, 295; Sunflower, 271; Illinois, 270; Yazoo, 226; Black (Arkansas), 112; Green, 200; St. Francis, 180; Tallahatchie, 175; Wisconsin, 160; Deer Creek, 116; Tensas, 112; Monongahela, 110; Kentucky, 105; Bartholomew, 100; Kanawah, 94; Muskingum, 94; Chippewa, 90; Iowa, 80; Big Hatchie, 75; St. Croix, 65; Rock, 65; Black (Louisiana), 61; Macon, 60; Bœuf, 53; Big Horn, 50; Clinton, 50; Little Red, 49; Big Cyprus and lake, 44; Big Black, 35; Dauchitte, 33. Total number of rivers, 33; total number of miles of navigation at present, 15 710.

ON FIRE-HYDRANTS, WITH DESCRIPTION OF ONE IN USE AT HALIFAX, N. S.*

BY EDWARD HENRY KEATING, CITY ENGINEER, MEM. INST. CIVIL ENGINEERS.

The most simple form of hydrant is a stand-pipe with one or more hose-couplings at the top, and a water-valve at or near the base. If the valve is so arranged that, in the act of closing it, a waste-valve is opened, by which the stand-pipe will be drained or emptied of water, the apparatus in many situations will probably answer the purpose as well as some of the more costly appliances.

There are, however, some objections to this form of hydrant, especially in climates subject to frost and snow. If the locality is one where the thermometer at times falls many degrees below freezing point, and deep snow lies upon the ground for days or weeks together, the inconvenience and delay caused by the necessity of measuring to ascertain the position of the valve, and in digging through snow or ice to reach it, may be great; while during the time that these operations are being performed a conflagration may gain serious headway.

In such localities it becomes of the first importance to adopt some form of hydrant that can be at once got at and controlled by the firemen, without the necessity of searching either for its position, or for that of the valve by which it is regulated.

In design the chief matters needing attention are:

1. Simplicity as far as practicable.

2. That all the different parts be durable, not liable to derangement, and strong enough to withstand rough usage at the hands of inexperienced, careless or excited men.

3. That it may be relied upon during frost without the necessity of frequent inspection.

4. That the stand-pipe and valves be so proportioned as not to affect the free delivery of water at the nozzles.

5. That it may be easily removed for repairs or replaced.

6. Perfect drainage.

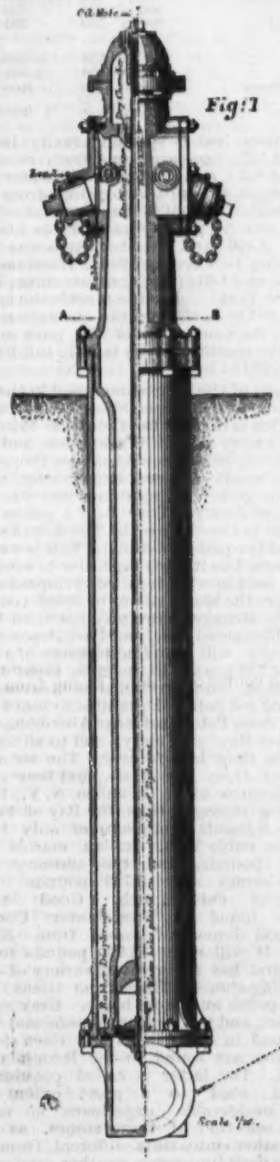
At Halifax during winter the maximum thermometer ranges between + 40° and + 60°, and the minimum thermometer between + 20° and — 10° Fahrenheit; although at intervals of several years the thermometer has been known to fall as low as — 20°. The climate, being affected by the Atlantic and oceanic currents, is moist and changeable. Usually there are periods during which the atmosphere is clear and bracing, succeeded by a few days of rain, and sometimes fog. Snow sufficient to allow good sleighing often remains upon the ground for a few weeks at a time; while after the periodical changes from wet to dry and cold, the whole surface of the country is occasionally covered with a glaze of ice. Frost penetrates the ground to a depth of from 3 to 4 ft., and in clay soils to about 5 ft.

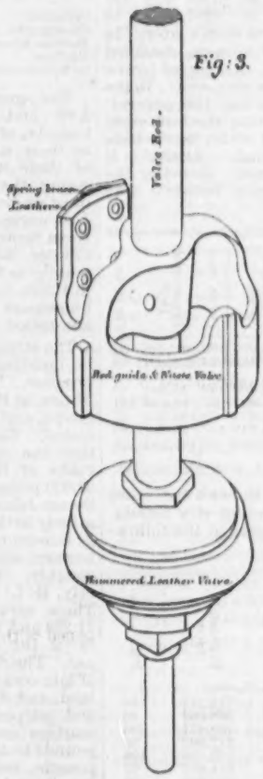
The water mains as a rule are laid at a depth of 5 ft. from the surface of the street to the top of the pipe.

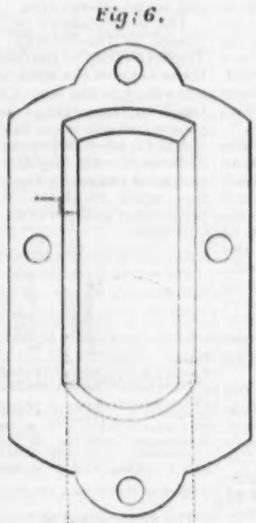
There are about 300 hydrants in the city, at distances apart varying from 250 to 450 ft., the usual interval being 300 ft. Most of these hydrants are of an old style, set in a brick well or chamber built for their reception below the foot-path adjoining the curb. In outward appearance they resemble in some respects Fig. 1, with the casing or frost jacket removed, but are dissimilar in detail and construction. The chamber is covered by a cast-iron plate provided with a hatch, by which access is gained to the bottom of the hydrant where it joins the branch from the main. This arrangement, although possessing some advantages and admitting of the easy removal of the hydrant, was considered by the author objectionable for several reasons, principally on account of the difficulty and expense in keeping the valves free from ice, and the large iron sidewalk plate becoming smooth and dangerous.

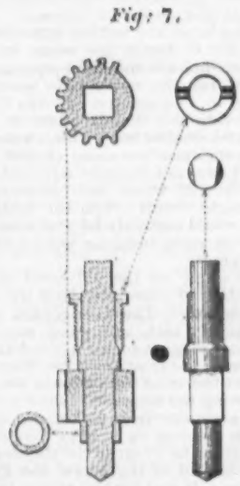
From four to five men were constantly employed throughout the winter, whose daily duty it was t amin eex each hydrant, thaw out the ice from an

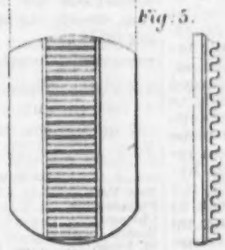
*From minutes of Proceedings of the Institution of Civil Engineers, Session 1879-80.

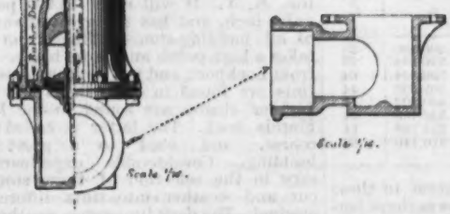


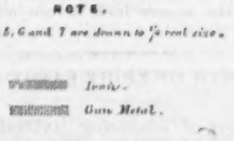












NEW FIRE HYDRANT, ADOPTED IN HALIFAX, NOVA SCOTIA.

which should be found frozen up, and to see that they were in proper working condition.

The hydrant, Fig. 1, was designed and adopted by the author after a careful inspection of many others, and after consultation with practical men connected with the fire departments of Halifax and other Canadian cities. It is not claimed that all the details are original. The main valve and the rod-guide, which also forms the waste valve, Fig. 3, are the same as in an American hydrant known as "the Matthews hydrant," and the gate, or cut-off valve, at each nozzle (Figs. 5, 6 and 7) is partly the invention of a local mechanic. The object of the latter contrivance is to allow the hose to be coupled to, or uncoupled from, one nozzle at any time, without interrupting the stream of water from the other. In the absence of some such arrangement it frequently happens during a conflagration that only one nozzle can be utilized, and, in the experience of the author, serious troubles have arisen between different authorities for the want of a similar provision.

The spring brass and leather attachment to the rod-guide (Fig. 3) forms the waste valve. There are two waste-holes in the stand-pipe against which this valve works, the upper hole being ½ in. and the lower $\frac{5}{16}$ in. in diameter. It was found necessary to provide this double waste on account of the lower and smaller hole, which was at first the only one, sometimes becoming choked with sediment, and it was not thought advisable to enlarge it, as considerable waste and consequent loss of pressure might result while the hydrant was in use. This would certainly be the case unless the main valve in each instance were screwed down to its full extent.

The main screw on the valve-rod is protected from the action of water and frost by a partition and stuffing-box. The frost-jacket is securely bolted to the iron seat, and when once set never need be removed. It forms a dead-air chamber which prevents the frost from reaching the main valve, and at the same time affords the means of easily removing the hydrant. Some hydrants provided with a similar frost-jacket are made to fit tightly upon the seat by a large screw turned at the base; but in the event of the slightest derangement to the thread of the screw the hydrant becomes useless. It was for this reason that the author adopted a flange joint. The flanges are turned perfectly true and a rubber diaphragm is made to fit into a dove-tailed groove on the stand-pipe flange, so that when the hydrant requires to be taken up there is no danger of the diaphragm remaining down to cause inconvenience. The hydrant can be readily removed by unscrewing the nuts just above the pavement, and another can as readily be inserted. The effect of tightening up the nuts is to compress the diaphragm between the flanges at the base.

Many of these hydrants have now been in use for the last two years with scarcely a case of stoppage or derangement; they are frost proof, and are believed by the author to be more reliable and suitable to the climate than any that have yet come to his notice. They are manufactured at a cost of $66.50 each, completed and ready to set up. Each hydrant is tested by hydraulic pressure to 200 lbs. on the square inch before leaving the workshop.

THE GROWTH OF EIGHT LARGE CITIES.

The tendency of advancing civilization is to dense centers of population. From one-thirtieth of our population in 1790, the city portion has increased to one-quarter of the entire population of the country. Such inducements as our cities afford prove too attractive for the rural population. The strong lights and shadows of our cities, the love of society, the satisfaction of better shelter, better roads, stronger institutions, lead men to crowd together even when unable to be anything but dependents in the system to which they unite themselves. Great enterprises demand massed effort; the individual often sinks his own will, his own property, his own happiness, present and prospective, in the tenement house of the city, when he might have been an independent man with a fair competence had he been contented with a rural life. The pre-eminent success of a few in the vast commercial enterprise, in manufactures, in public affairs, tempts those living in the rural districts to the centers of energy, and hope keeps them there till many of them cannot get away.

Dr. J. H. Bridges, in an address delivered before the National Health Association of London, made the statement that six out of each eleven persons living in London were born outside of it. The same holds true to even a greater extent in the large cities of the United States. Dr. Bridges claims that as a usual thing these people do not regret having left the country village. There is no homesickness. Why? Because village life is dull; because in London, with its vile lodgings and precarious struggle for existence, there is excitement, there is life by the brain. There is a rich multiform drama every Saturday night in the Whitechapel road—flaring gas light, strong lights and shadows, carts of vegetables and cheap fruits, variety of strongly-seasoned food, toys, colors, shop-windows, street cries, collisions, medleys, of all sorts, and stimulating social intercourse.

The development of American cities was discussed in Bradstreet's, April 30, 1881, and of Western cities in particular a few weeks later. In these articles the statistics of population, classified according to the size of the city, as reported by the tenth and preceding censuses, were given. In the present article some tables showing the percentage of increase in population during the last eight decades in our eight principal cities have been prepared expressly for this journal. Attention is first called to the following table, showing the population and per cent. of increase between 1810 and 1840:

	Population 1810.	Population 1820.	Per ct. inc.	Population 1830.	Per ct. inc.	Population 1840.	Per ct. inc.
New York	96,377	123,706	28	203,007	63	312,710	54
Philadelphia	96,691	108,116	12	167,188	54	258,037	54
Chicago	.....	.....	....	.....	....	4,479	....
Boston	32,250	43,298	34	61,392	42	93,383	52
St. Louis	.....	4,598	....	5,852	27	10,469	181
Baltimore	46,555	62,738	35	80,625	29	102,313	27
Cincinnati	2,540	9,644	279	24,831	157	46,338	87
New Orleans	17,212	27,107	57	46,310	70	102,193	121

The next period of forty years shows a still more remarkable per cent. of increase in city population, which can be seen by a glance at the following table:

	Population. 1840.	Per ct. inc.	Population. 1860.	Per ct. inc.
New York	515,507	65	814,277	58
Philadelphia	408,762	58	568,034	36
Chicago	29,963	569	109,424	265
Boston	136,881	47	177,902	30
St. Louis	77,860	373	162,179	108
Baltimore	169,954	65	214,037	27
Cincinnati	114,436	147	160,060	39
New Orleans	116,375	14	170,766	46

	Population 1870.	Per ct. inc.	Population 1880.	Per ct. inc.
New York	942,292	16	1,206,590	28
Philadelphia	674,022	19	846,984	25
Chicago	306,605	180	503,304	64
Boston	250,526	41	365,835	44
St. Louis	310,864	91	350,522	13
Baltimore	267,354	25	332,190	24
Cincinnati	216,239	35	255,708	14
New Orleans	191,418	12	216,140	13

The marvelous growth of population in these eight large cities of our country shows perhaps bet-than anything else the great expansion of human settlements and of material civilization which are the most striking features of the memorable epoch in the history of the United States which began with the discovery of gold thirty years ago.

STRENGTH OF BUILDING-STONES.

The recent conflagration in this city, causing the destruction of a so-called fire-proof building (Morrell's warehouse), calls attention to the subject of the durability of building-stones in general. Dr. Hiram A. Cutting, of Vermont, has made some valuable and interesting experiments to determine the amount of heat the various building-stones in use will stand, and has extended his experiments to twenty-two kinds of granite, twenty-three of sandstone, seven of limestone, seven of marble, three of conglomerate, one of slate, one of soap stone and one of artificial stone. Under the application of the heat the granite (1) began to yield at a temperature between 700° and 800° F., (2) became cracked between 800° and 900° F., (3) became generally cracked between 800° and 950° F., and (4) was made worthless by or before reaching a temperature of 1,000° F.

The following table contains these results, and those also for the other kind of stones, the stages of destruction being indicated by the inclosed numbers:

	Degrees. (1.)	Degrees. (2.)
Granites	700 to 800	800 to 900
Sandstones	800 to 900	850 to 1,000
Massive limestones	850 to 950	900 to 1,000
Marbles	900 to 1,000	950 to 1,000
Conglomerates	600 to 700	700 to 800
	(3.)	(4.)
Granites	800 to 950	At or below 1,000
Sandstones	900 to 1,000	1,000 to 1,200
Massive limestones	900 to 1,100	Mostly 1,200
Marbles	1,000 to 1,200	1,200
Conglomerates	800 to 900	900 to 1,000

The granites had a specific gravity between 2.600 and 2.727, excepting one from Stanstead, Canada, of 2.833; and immersion in water added to their weight, through absorption, from 1-280 of their weight to 1-818. In the case of sandstones, the specific gravity is 2.168 to 2.661, but most under 2.400; and the absorption was 1-17 to 1-80, excepting two giving 1-240 (a freestone from Nova Scotia) and 1-314 (the Montrose stone, Ulster County, New York). For the marble the specific gravity is 2.666 to 2.848, and the absorption 1-300 to 1-380; for the more solid of the pure massive limestones the specific gravity is 2.478 to 2.706, and absorption 1-280 to 1-480.

The strength of the large stones used in our public buildings is tested by machines made for the purpose. This is done at the Columbia School of Mines, at the navy yard in Washington, and other places, and every stone known has been thoroughly tested. The result of these experiments shows that the strongest building-stones are the trap rocks of New Jersey. They bear a pressure of 24,000 pounds to the cubic inch. The dolerite from Staten Island is equally as strong. This is comparatively little used, as it is too expensive to work, but is, however, used in what is called cyclopean architecture, where the blocks are to be fitted together roughly. The strongest granites come from Westerly, R. I.; Richmond, Va., and Port Deposit, Md. These severally will stand a pressure of 17,750, 21,250 and 19,750 pounds to the cubic inch. Granite is the most durable of all stone in every-day use. The fine red polished granites so much used of late come from Peterhead, near Aberdeen, Scotland, and the Bay of Fundy, and to all intents and purposes they last forever. The strongest marbles come from Lee, Mass., and bear 13,440 pounds to the cubic inch: Tuckahoe, N. Y., 12,950 pounds, being stronger than the Bay of Fundy granite, which stands a pressure of only 11,812 pounds to the cubic inch. Italian marble will bear 11,250 pounds, and the statuary marble from Carrara only 9,723 pounds pressure to the cubic inch. Good rough marbles are found in Westchester County. The strongest limestone comes from Kingston, N. Y. It will resist 13,900 pounds to the cubic inch, and has the greatest variety of color of all building-stones. That from Glens Falls takes a high polish and is jet black. Gray comes from Lockport, and the delicate cream and dove tints are found in the Athens and Caen stones. Lighter shades are found in the Bermuda and Florida rock. The latter is called coquina, is coarse, and used to a great extent in building. Considerable experience is necessary in the selection of these stones, as they cut and weather into tints different from the original. The dark limestones weather gray oftentimes by the oxidation of the coloring matter.

The gray Lockport stone when dressed by the hammer resembles a light granite, and is consequently used for trimming brick houses. The cream-colored limestone of the Paris basin is very soft at first, and would be esteemed by a green hand unfit for any purpose, but it hardens when dressed, and the most delicate work can be done, the exposure that would chip the work in other stones being its preservative. The Topeka stone, now much used from Kansas, possesses the same valuable property. It can be sawed like wood in any shape. The limestones that are most valued, however, in this country, come from Dayton, Ohio; they are greatly used by Cincinnati builders. In Chicago the favorite limestone is the Athens, before mentioned, from Northern Illinois. These were deposited by the great seas of the Niagara period of geology.

The lighter stones come from the Ohio, and belong to the lower carboniferous. A medium between the two in color comes from Amherst,

Both are excellent as resisting fire. Many of the finest buildings in Cincinnati are built of the Waverley sandstone of a light dove color. Other rich stones are the St. Genevieve from Missouri, straw-colored and finely grained. All these stones will stand a greater pressure than is ever demanded of them, 50,000 pounds to the square foot being, perhaps, the maximum. The pillars of All Saints' Church at Angiers sustain a pressure of 86,000 pounds to the square foot, and the columns of the Pantheon 60,000 pounds.

LIVERPOOL ENGINEERING SOCIETY.

The twelfth meeting of the session was held on Wednesday evening at the Royal Institution, Colquitt street, at 8 o'clock, Mr. A. J. Maginnis, Vice-president, in the chair. A paper on "Tides and Tidal Scour" by Joseph Boult, Esq., was read by the author. In the first part, the author pointed out that the equilibrium theory of the genesis of tides had been found unsatisfactory by Dr. Whewell, Sir W. Thomson, and other investigators. That theory assumes the generation of a great tidal wave in the Indian Ocean, which travelling westward produced the phenomena of tidal action upon each coast in its progress. It was suggested this assumption involved the idea of spasmodic action, which, if it existed, would propagate concentrical waves, like the ripples produced by dropping a stone into smooth water. It was also suggested that, as the lunar and solar attraction and the earth's gravity acted in opposite directions—particles on the earth's surface being drawn toward its center and toward the moon and sun—the amount of free centrifugal force would vary with the relative position of sun, moon and earth; its greatest development being when the sun and moon were in conjunction or in opposition, at which relations tidal action is greatest. Thus the genesis of tides, instead of being spasmodic and wave-like, is continuous, acting upon each meridian in turn. It was further suggested that anomalous tidal action may arise from two causes. 1st. From the greater development of centrifugal force at the equator, where the velocity of the earth's surface is greatest, than towards the poles, where that velocity gradually disappears, the poles being stationary. 2d. From the tendency of the equatorial excess to pass off towards the poles. A third cause is to be found in obstructions arising from the configuration of the earth adjacent to tidal water, which produces retardation. That the force so diverted found in the Arctic and Antarctic frozen seas, accumulating chambers, in which the parts arriving from the Atlantic and Pacific were combined, and escaping, returned towards the equator, on the line of least resistance. Thus might be explained the fact by which Whewell was so perplexed, viz., that in the North Atlantic the tides on the west coast of Europe are subsequent to or later than those of the same age on the east coast of America. In the second part attention is drawn to the great improvements which have been accomplished in the harbors of Dublin, Glasgow, Perth, Preston and the Tyne through the removal of obstructions to the passage of tidal force. The treatment had varied with local conditions, but the general principle was to reduce the bed of the river to a gentle slope at a considerable depth, and to increase or diminish the breadth of the channel. Thus the velocity of flood had been rendered more uniform, and on the whole increased, and more time secured for the discharge of the upland waters at a more uniform rate, upland water being the most efficient natural agent for deepening and maintaining the channel. Most of the improvement referred to was, however, to be ascribed to continual dredging, including in that term every artificial method by which those channels were deepened and widened; and dredging was essential to the maintenance of the channels, notwithstanding the invaluable assistance given by tidal force. The vice-president announced that the author would read the second part of his paper at the next meeting of the Society, which would be held on the 23d inst., when a discussion would take place on the subject of the paper. The paper was illustrated by numerous diagrams.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Appleton, Wis., has decided on water-works.

Water is supplied to the houses in Pullman, Ill., from the Hyde Park water-works.

Fort Dodge, Ia., has accepted the water-works just finished at that place.

Five Wells have been sunk at Blissville to increase Long Island City's water supply. They are expected to yield 2,000,000 gallons a day. The present supply is 1,500,000.

Litigation begun in Vincennes, Ind., is likely to prevent the water-works company from laying its mains, on the ground that the city debt has reached its limit, and no new bonds can be issued.

The Daniel Shaw Lumber Company, for a considerable period, used its influence to have some extent to a system of water-works created by the city of Eau Claire, Wis. Failing in that end, the company determined to establish water-works of its own.

The Owego Water-Works Company, of Owego, N. Y., have just put in a large new Dean pump with condensing attachment, for the purpose of supplying the village in case of failure of the reservoir. Cost, about $1,000.

The flooded coal mine at Streator is estimated to contain 300,000,000 barrels of water, and the present pumping facilities will require 450 days to remove it. It is proposed, however, to cut a tunnel from Vermillion River to the mine, which would soon drain it.

The New Haven Water Company is considering a proposed new contract with the city. Gov. English said, at a recent conference, that the company's stock is too high at 80, and he thinks the company should spend at least $500,000 in improving the works, which have been neglected because of the uncertainty of the city's action. A new source of supply and larger mains are needed.

The engineer employed by the city of Lincoln, Neb., to examine the practicability of large wells to supply the city with water, reports that a well 50 ft. in diameter by 80 in depth, to cost between $5 000 and $10,000, would afford ample supply for all purposes. The engineer estimates that the entire cost of water-works, including 12 miles of main, at from $94,000 to $100,000.

A green substance, supposed to be the same as the fresh water sponge described by Prof. Remsen as being the cause of the foul odor and taste of the Boston water, is known to have existed in the Hartford water supply, and masses of it have been found growing in the pipes and adhering so closely that they could not be pulled off, though they could be scraped away. It remains to be seen if this is the true and only cause of the present trouble, and if it is, it is hard to see how the flushing can wholly cure the evil, since what cannot be pulled off will hardly wash away under the pressure of any current that can be produced. Any matter sufficiently disorganized to have lost its hold on the pipe can of course be removed in this way, and thus an improvement can be made, even if the trouble is not wholly eradicated.—*Hartford Post.*

FRESH-WATER SPONGES.—In the course of an interview with a Boston *Advertiser* reporter, Prof. Hyatt, while considering the subject of fresh-water sponge, the supposed cause of the bad taste and odor in the Boston water supply, said: "Fresh-water sponges are found in the ponds of New England and as far north as Canada. They are an annual product of growth, and flourish in this region during the summer months and somewhat late in the fall, but perish, and their substance decays as the cold weather comes on. Contrary to the opinion formerly held by writers on natural history, the sponge belongs to the class of animal life The explanation of the non-discovery of these sponges in examinations made on former occasions when the water supplied to the city had been bad, is doubtless in the circumstance that the examinations were made after disintegration and decomposition had taken place. The annual growth is maintained by the deposit of seed bodies, which remain in the water or upon the bottom during the cold season. The substance of the fresh-water sponge is much less dense than that of the sponge of commerce. It is of the softest tissue, and dries to a papery film. These sponge growths are not found in all fresh-water ponds. Where it abounds the water is more or less nauseous and unfit to drink. Being an animal, the sponge gains its sustenance and growth by feeding, and absorbs for its food both microscopic animals and vegetable substances that float in the water. Though in no case, so far as known, poisonous, the sponge is not an edible for any of the higher animals, and neither fish nor water-fowl feed upon it. The formation of the sponge found at Farm Pond was that of a mass of small, finger-like growths, spreading in a branching or bush-like manner from the more compact part, by which it attached itself to whatever fixed and firm substance might lie in the water. These finger-like projections were some of them 3 or 4 in. in length, though most of them were much shorter." Professor Hyatt has seen them of 18 or 20 in. length.

STREETS, DRAINAGE, ETC.

Montreal has appropriated $40,000 for street paving.

The Decatur (Texas) Court-house, valued at $155,000, was burned on the 28th ult.

BLOOMINGTON, Ind., Nov. 21.—A corps of government civil engineer is in this locality surveying the thirty-ninth parallel line across the continent. They say that Bloomington is 800 feet above the sea.

It is reported that Edison is to build 50 miles of experimental electric railway between St. Paul and St. Cloud for the Northern Pacific road. If the engines succeed, Edison will furnish the motive power for the road.

A Youngstown (O.) dispatch, dated Nov. 20, states that the contract for all the inlet work on the Pittsburg, Youngstown & Chicago Railroad, from Newcastle to Pittsburgh, was let on Thursday to one of the heaviest firms in the United States.

Mr. Horace J. Beemer, who has been awarded the contract for the difficult work embraced in the completion of Section 22 and of the Welland canal enlargement, has deposited the necessary 5 per cent with the government. It will amount to something like three-quarters of a million dollars.

The plans for a large freight shed to be erected by the Arrow Shipping Company, of Newcastle-on-Tyne, England, on the new pier, No. 56 North River, have been filed at the Bureau of Inspection of Buildings. The structure will be 75 by 480 ft. in dimensions and will cost $25,000. It will be built of wood and corrugated iron.

A meeting of residents of Washington Heights, Fort Washington and Inwood was held on Thursday night to adopt measures for improving the foot-bridge at 155th street, for hastening the construction of the proposed suspension bridge north of High Bridge, and of a surface railroad on Tenth avenue from Manhattanville to High Bridge and beyond.

BRIDGES.

Bridges are to be built over the Fox River, Ill., at Yorkville and Bristol.

The Erie Railroad Company has spent over $90,000 in strengthening and protecting the mason work of Portage Bridge.

The St. Paul, Minneapolis & Manitoba Railway Company has decided upon the construction of a bridge across the Mississippi at Minneapolis.

An appropriation of $2,500, has lately been made in Binghamton to build a foot bridge at the foot of Exchange st. The work will probably be deferred until spring in hopes of being able to increase the amount.

A dispatch from Ottawa, Canada, states that applications have been made to Parliament for a charter for a drawbridge across the St. Croix River, between New Brunswick and the State of Maine; and also for an act to incorporate "The Niagara Peninsular Bridge Company," to build and work a bridge for railway and other purposes across Niagara River at or near the village of Queenston, with the usual powers.

The Chicago City Council has directed the Commissioner of Public Works to prepare and submit to the Council an estimate for the construction of a bridge at Taylor street. It is proposed to include the amount in the estimate for 1882. The estimated figures are as follows: For substructure, including approaches, engineering, etc., $25,000; wrought-iron bridge, $16,500; dredging, 16,000 cubic yards at 30 cents per yard, $4,800; 21,642 square feet of land to widen the river, at $2.50 per square foot, $54,105; 550 lineal feet of dock at $10 per foot, $5,500—making a total cost of $105,905. The above estimate includes trestlework for approaches, as it is assumed that the railroads will, in the near future, require substantial viaducts over their tracks.

Notice is given that application will be made to the Legislature of the State of New York, at its next session, for an act to incorporate a company with power to construct and maintain a bridge for railroad purposes, over the river St. Lawrence, between the village of Waddington and some point on the Canada shore, to be operated in connection with a railroad to be constructed from Ottawa, Canada, through Waddington, N. Y., to a connection with the Adirondack Railroad, at Canton, N. Y.; said company to be known as the Ottawa, Waddington & New York Railway and Bridge Company.

JAMES REDINGTON,
Attorney for Applicants.

WADDINGTON, Nov. 3, 1881.

The Ottawa *Free Press*, in an article on the Ottawa, Waddington & New York Railway, after quoting from the article published in the *Plaindealer* some weeks ago a paragraph speaking of Ottawa as the great central point of railroad trade for the Dominion, says:

"The O., W. & N. Y. Railway is projected with a view to tapping this great trade, and, being 45 miles shorter from Ottawa to New York than by any other route, it fairly claims the attention of capitalists and business men on both sides of the boundary. The preliminary survey shows exceptional facilities for railway construction, and the site chosen for bridging the St. Lawrence is said to be the best along its course above Montreal. The line has many things to recommend it, and we hope the gentlemen who have taken it in hand will push forward their enterprise, for it is bound to be a success."

RIVERS AND HARBORS.

Canadian engineers take very little stock in Mr. Shearer's plans. There is not overmuch depth of water in Montreal harbor now, and to cut off a portion of the current would lower it too much.

A Montreal dispatch of the 28th ult. says that a party of English engineers were to-day looking into Mr. James Shearer's scheme for a dam and subway over the St. Lawrence to St. Helen's Island. They examined the plans, drove to the proposed site of the dam, and had a look into the channel between St. Helen's Island and the south shore. They are highly favorable to the scheme, and pronounce it feasible both from an engineering and financial standpoint. The estimated amount required to build the roadway, etc., is about $4,500,000, and the road duly bonded, and rental accruing from road privileges and water-power rental would in time pay for the whole cost of the undertaking.

RAILROADS.

The track of the Chicago, Texas & Mexican Railroad was completed to Cedar Hill on the 30th ult.

It is generally understood that the Canada Pacific Railway workshops and locomotive works will be placed at Montreal.

A Marshall (Tex.) dispatch says that $300,000 were deposited there last week for the construction of the first 30 miles of the Sabine Pass & Texas Northern Railroad from Marshall southward.

The Means tunnel, on the Elizabethtown, Lexington & Big Sandy Railway, is completed, opening the Chesapeake's all-rail connection via the Kentucky Central to Richmond, Va., and to Newport News, on Deep Water.

Negotiations are in progress with the New York, Lake Erie & Western for the use of the Cincinnati division of the Toledo, Delphos & Burlington as an outlet of business via Dayton. Trains will probably run through from Dayton to Cincinnati within fifteen days.

COLUMBUS, O., Dec. 1.—The Cleveland, Akron & Columbus Railway Company, with $4,000,000 capital, was incorporated to-day by Charles J. Canda, L. A. Russell, George D. Walker, Conrad Halsee and Goshorn A. Jones, who recently purchased the railroad at judicial sale.

The passenger earnings of the Erie road for the last fiscal year amounted to a little more than $4,000,000, an increase of almost $1,000,000 over the year ending Sept. 30, 1879. For this immense gain great credit is due Mr. J. N. Abbott, who has shown himself to be one of the best passenger agents in this country.

The Denver & Rio Grande Railroad Co. has notified the Stock Exchange of an issue of $5,000,000 of its capital stock, the entire amount having been negotiated, we are informed, in London. The issue is intended for the purpose of extending the lines in Colorado, for laying a third rail between Denver and Pueblo, for making the necessary changes in superstructure therefor, and for other improvements.

Louisville and Nashville stock touched par on Wednesday. The road is doing the best business in its history, and the contract reported to have been made by which it allows the Chesapeake and Ohio to come into Louisville over the Lexington branch of the Louisville & Cincinnati Short Line gives the Louisville & Nashville Company the right to regulate the rates from Louisville to the seaboard cities, which will add greatly to the through business of the road.

The Commissioner of the General Land Office denied the application of the Atlantic & Pacific Railroad Company to be allowed to procure government surveys of lands along its line, in New Mexico and Arizona, by means of depositing the estimated cost thereof, under provisions of Sections 2,401-3, Revised Statutes. Commissioner McFarland holds the privilege accorded by those sections is confined to settlers residing in townships to be surveyed, and that corporations are not "settlers" within the meaning of the statutes.

"The Steel Association of Ontario" is the name of a recent applicant for letters-patent, the hadquarters to be in Belleville, Ontario, capital to be $700,000 in shares of $50 each. The promoters are chiefly from Buffalo and Cincinnati. The object of the company is the seeking for acquiring and working iron mines in Ontario, the purchase of iron ore, the establishment of smelting works and works for the production of steel under such processes and patents as the company may acquire or have the right to use; also for the purpose of manufacturing articles from steel and also from iron, and for the sale of all the said products; also for the purpose of buying, importing and selling coal.

All the rolling-mills for iron and steel rails have contracts ahead to an extent that will require their utmost power of production for several months running. As a consequence, prices have materially advanced. From present indications, based upon actual contracts made for future delivery of all kinds of railroad supplies, there may be more miles of railroad constructed in 1882 than during the year now drawing to a close, which will show more miles of new railroad constructed than before since 1871. The Union Pacific road needs many new locomotives at once, and can make contracts for delivery no earlier than in 1883.

COST OF RUNNING TRAINS.—The annual report of the working of English railways gives the following items in regard to cost per train mile of all trains run in 1880, as compared with the year before. The figures given are reduced to cents in American money:

Account.	1880.	1879.
Maintenance of way	11.55	12.12
Locomotive power	15.45	15.56
Rolling stock	5.76	5.52
Traffic expenses	19.19	19.78
General charges	2.72	2.77
Rates and taxes	2.98	3 09
Government duty	1.48	1.52
Personal injuries	0.44	0.42
Damage to goods	0.34	0.38
Legal and parliamentary	0.53	0.44
Miscellaneous	1:14	1.14
Total	61.58	62.74

The Supervisors of Tioga County, N. Y., are contemplating building a new jail and residence for the Sheriff in connection with it, to be located at Owego. Plans will be submitted shortly. The Owego *Times* of the 24th inst. says: "We are pleased to learn that the Supervisors generally are in favor of a new jail. The old site is likely to be chosen; indeed, it could not be bettered. It is central, yet sufficiently secluded, and the county possesses enough land for all purposes. The material of which the structure will be built is not, as yet, decided upon, nor has the plan, as yet, been definitely fixed upon. The principal difficulty with the present shell is partly in the material, partly in the want of ventilation, but specially in the total want of sewerage. It is impossible to keep it smelling properly. But now that we have got water, a good sewer should be constructed into the Susquehanna River at or near the bridge. The parties owning property along this route would gladly bear their part in the expenses of such a public convenience."

On the 23d ult. the Texas Southern Trunk Line Railroad Company and Telegraph and Express Company filed articles of incorporation at the office of the Secretary of State of Texas. The scheme comprises a system of local connections, embracing in all something in the neighborhood of 1,300 miles of railroad of narrow gauge. It is designed to control the trade of the State in the direction of Texas gulf ports. The following extract from the charter shows the route: "The place from which said Texas Southern Trunk Line Railroad Company and Telegraph and Express Company shall be constructed and operated is Galveston, in Galveston County, and Houston, in Harris County, and running through Montgomery and Grimes counties, to or near Madisonville, in Madison County; to or near Centerville, in Leon County; to or near Fairfield, in Freestone County; to or near Corsicana, in Navarro County; to or near Waxahachie, in Ellis County; to Fort Worth, in Tarrant County; through Parker County, Wise County, Jack County; to and through Clay County; to or near San Thomas, in Archer County, with a branch from or near Centerville, in Leon County; to or near Groesbeeck, in Limestone County; to or near Waco, in McLennan County; to or near Meridian, in Bosque County; to or near Stevenville, in Erath County; to Eastland, in Eastland County; to or near Breckenridge, in Stevens County; to or near Camp Cooper, in Throckmorton County, with a branch from Corsicana, in Navarro County; to or near Kaufman, in Kaufman County, to Greenville, in Hunt county; to or near Cooper, in Delta County; to Paris, in Lamar County; also a branch from Greenville, in Hunt County, to Bonham, in Fannin County, and a branch from or near Waxahachie, in Ellis County, to Dallas, in Dallas County; also a branch from Aurora, in Wise County, to or near Denton, in Denton County, and with branches from or near Denton to Sherman, in Grayson County, and Gainesville, in Cooke County; also a branch from the main line, in Montgomery County, through Liberty and Polk counties, to or near Woodville, in Tyler County; also a branch from the main line, in Montgomery County, to or near Hempstead, in Waller County, through Austin County; to or near La Grange, in Fayette County; to or near Bastrop, in Bastrop County; through Travis County, to the intersection of the Austin & Northwestern Railroad, at or near Round Rock, in Williamson County; to or near Georgetown, in Williamson County; to or near Belton, in Bell County; to Waco, in McLennan County; also a branch from or near Bastrop, in Bastrop County; to or near Lockhart, in Caldwell County; to or near San Marcos, in Hays County; also a branch from or near Lockhart, Caldwell County; to or near New Braunfels, in Comal County; to or near San Antonio, in Bexar County; to or near Boerne, in Kendall County; to or near Kerrville, in Kerr County; with a branch from or near Boerne, in Kendall County, to or near Fredericksburg, in Gillespie County, and Mason, in Mason County, at the intersection of the Austin & Northwestern Railroad. The main line and branches to be constructed along the most practical and expedient route in the counties aforesaid." The principal business office shall be established in Houston, with branch offices in Galveston and Austin. The capital stock is $15,000,000, at $100 per share.

NEW PROJECTS.

The Painesville Water and Steam Heating Co., of Painesville, O.; capital $200,000.

The Edison Company for Isolated Lighting, with a capital of $500,000, has filed articles of incorporation in Albany.

The articles of incorporation have been filed in Albany of the Santa Martha Railroad Company, with a capital of $2,500,000; the road to be built in the United States of Colombia.

Fort Hope intends making application to the Ontario Legislature for power to make an additional issue of debentures for the purpose of encouraging the establishment of new manufactories, and for the further extension of the water-works.

The Millbank, Kibby & Tower City Railroad Company has been organized in Dakota; capital $200,000. The company proposes to build a railroad from Tower City to Millbank, where a junction will be made with the Chicago, Milwaukee & St. Paul Railway.

A charter has been granted to the Ohio River & Lake Erie Railroad Company, which proposes to build a line from the vicinity of Sharpsville, Mercer County, to Girard, Erie County. It is to be 60 miles in length. The capital stock is $3,000,000.

The Middletown, Lebanon & Cincinnati Railroad Company, capital $100,000, has been incorporated by H. P. Clough, C. H. Wardlow, D. L. Brisch, John Cunningham and C. F. Gunckel, with offices at Middletown, and passing through the counties of Butler and Warren. It is understood that this is to be a local line between Middletown and Lebanon.

The Guideau Springs Railroad Company have filed their charter with the Secretary of State of Kansas. The company propose to build a road from Arkansas City, Cowley County, Kan., by way of Mineral Springs, to Dodge City, Kan. The length of the line will be about 200 miles. The capital stock is $200,000. Guideau Springs will be the headquarters of the road.

The Chicago, Missouri & Kansas Railroad Company has filed articles of incorporation in Topeka, Kan. The road is to run from a point on the Missouri River, in the County of Saline, Mo., to the west line of the State of Kansas, with a branch to Dodge City, the estimated length to be 600 miles. The company's headquarters will be at Oswego, Kan. The capital stock of the company is $15,000,000. The Directors are: A. A. Harris, Fort Scott, B. F. Hobart, C. M. Condon, F. A. Bitters and C. B. Sperry, of Oswego.

CONTRACTING, MISCELLANEOUS, ETC.

Plans are now being drafted for the Central Building of the Topeka, Kan., State House.

The time for receiving bids for the Austin, Texas, new capitol has been extended to Jan. 1 next. Chicago parties are in the field bidding for the work.

The Bryan (Texas) County commissioners have decided to build a bridge over the Wavasola River, to improve the public highways, and to build a new poor-house.

The Finance Committee of the Indianapolis, Ind., council reported the city treasury bankrupted, and that a loan of $70,000 was necessary to tide over the next four months.

The contract for the branch of seven miles to connect the Toronto & Nipissing and the Whitby, Port Perry & Lindsay, has been let to Geo. Wheeler, M. P. The work is to be completed by the 1st of September, 1882.

Contracts for all the grading on the Gulf, Colorado & Santa Fe Railroad between Lampasas and Copperas Cave, Texas, are now let. Jones & Cleod, Richer & Evans, have the contract for the first ten miles.

The city of Binghamton has just appropriated $4,800 for the purchase of a site on Canal street known as the Paige property, to erect a military armory and store house, to be used by the 20th separate company, N. Y. S. N. G., of that city.

The Dominion Government expect that the Canada Pacific Railway will be completed in 1890, at which time it is expected there will be a sufficient surplus of funds on hand to discharge the government's obligations on the road.

The New York, Indiana & Western Construction Company, capital $1,500,000, with the object of furnishing material to build railroads, has been incorporated at Indianapolis. A. J. Hodder, James T. Brady and F. V. Perrin, of New York, are directors.

A massive marine railway, 650 feet long and 50 feet wide, and capacle of hauling out a 1,500-ton vessel, has just been completed at Fair Haven, Conn. It is to be put up at Campeachy City, Mexico, and the cost of its construction and erection there will be nearly $500,000.

The enterprising firm of Brentnall & McDonald, of Bath, N. Y., have large contracts for masonry on the line of the New York, Lackawanna & Western Railroad. The new bridge masonry over the Chenango River at Binghamton, and the masonry at Sarona and Liberty, was constructed by this firm.

A contractor who has a claim of $150,000 proved up against the Indiana, Bloomington & Western Railroad, for grading and tying the line from Clinton to Havana, has for some time past been working in a lumber yard at Champaign at $40 a month. He wrecked a comfortable fortune in executing the contract.—*Chicago Times.*

Sturgeon Bay Canal (Wis.) is finished. Cost, $700,000. Mr. Jesse Spalding is President; Gen. W. E. Strong, Vice-President and Treasurer of the Canal Company; O. B. Green is the contractor, and W. F. Casgrain is the chief engineer. The company expect that the canal will afford an avenue for the passage of vessels aggregating one million tonnage annually hereafter.

PANAMA; Nov. 16.—Canal work along the line appears to have been suspended since the death of Mr. Blanchet. Surveys are progressing. Mr. Hersent, of the contracting firm of Couvreux & Hersent, and Mr. Dauzats, chief engineer of the Suez Canal, are on the way to the isthmus to put the work in shape and complete the organization begun by Mr. Blanchet, which, it is understood, was generally approved by the consulting engineers and others in Paris.

Some five hundred 640-acre land certificates, in the hands of the surveyor of Pecos county, Texas, were sequestered at Austin on the 19th inst. by Mr. R. Thomson, land agent. The certificates, which were issued to the Gulf, Colorado & Santa Fe Railway Company, were located in the Pecos land district, and Mr. Thomson claims that the surveyor's charges for survey and locating fees are about $6,000 more than the law allows. The certificates cover, for owners and the school fund, 640,000 acres of land.

The Wyoming County (N. Y.) quicksands are a source of great annoyance in the construction of any public works. In order to lessen a grade between Portage Bridge and Castile, the Erie has put in a loop line. This line makes a detour through a hill of quicksand and over a deep ravine. At the bottom of the ravine is a culvert built upon pile foundations, and extending down to the rock. The superincumbent weight of rock upon this treacherous mass of earth has caused the whole to sink, while the lower material is making preparations to move down the ravine. Already large forest trees have been carried downward toward the river bank, and fears are entertained that the whole embankment will slide out of position. The track repairers, who have raised the bank three times within as many months, now have substituted a short tangent to accommodate the running of trains. The culvert in the new road-bed has become to some extent demoralized, and information is now wanted how to hold the track to its original survey.—*Exchange.*

ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 10, 1881.

AT the meeting of the American Society on Wednesday evening, Mr. Ashbel Welsh occupied the chair, and there was a very full attendance of members. A committee on arrangements for the coming annual meeting in January was appointed, and it is expected that the meeting will extend over two days and prove very interesting and valuable to the attending members.

WE offer for every *new* subscription sent to us, with the money, a *cash premium* of *one dollar*, or *books* to the value of *one dollar and fifty cents*, and we prepay the postage on the books. If our readers will carefully review the past volume of ENGINEERING NEWS they will realize what a vast amount of information of value to engineers and contractors has been laid before them during the year. Can a more *newsy* class journal be named?

ONLY a few weeks of the present year remain, and we must again urge upon subscribers the necessity of securing back numbers while they can. Of some numbers we are entirely out, and it is useless to attempt to replace them; of such as are still on hand, we will fill orders while they last. After the close of the volume we will, without further notice, sell the remaining numbers as old paper; after which further chances for any part of this volume will be lost.

OF the original edition of Prof. Chas. E. Greene's "Graphical Analysis of Bridge Trusses," a work whose popularity has been steadily on the increase, there remain 110 copies. Last week we bought the entire lot and now offer them as an inducement for book buying, or for new subscribers. It is hardly necessary at this day and date, to specify the merits of this work, the enlarged edition of which is the very best selling book (at $2.50), on bridge construction now in the market. We will give one copy of the old edition for $1.25 cash, for one new subscriber, or free to the purchaser of three dollars worth of other books.

ORDERS FOR BINDING volumes of ENGINEERING NEWS will not be taken at this season of the year. In the holiday months and until well into the ensuing year, every available foot of storage room of the best binderies is occupied; from floor to roof unbound literature is packed away, much of it without insurance, and to the unaccustomed observer, in extricable confusion from which it might apparently never be rescued. As the summer months approach there is a better chance in job work, at better prices, and with a reasonable chance for completion. About May next we will take such orders for binding as may be sent us.

WE are indebted to the Indianapolis *News* for the correction of a paragraph which appeared in our last issue under the head of "Miscellaneous," and hasten to assure our readers that as a piece of news it appeared in a paper published so much nearer to Indianapolis than ourselves that we incautiously accepted it as something worth knowing. The fact of the city borrowing a certain sum of money to meet its expenses should have been sufficient evidence to one living in New York that the term bankrupt was scarcely applicable in the premises; and such reparation for its use as is afforded by this apology is cheerfully rendered.

OUR BOOK TRADE grows appreciably every succeeding day. No other bookseller in the United States is offering such inducements to buyers as we are. The Weale's series that we are *giving away* is not a collection of second-hand mutilated volumes, but it is the second largest and best stock of those popular works on this side of the Atlantic. We are daily filling the orders of booksellers from all over the country for them, and at regular trade rates. The best volumes are rapidly being taken, and with the renewal of subscriptions the stock will be pretty well thinned out by the additional orders for books. We advise intending book buyers to lose no time in sending us their orders if they would secure the advantage of our present offer of free books.

AS a very fair indication of the activity in all kinds of surveying operations, and especially in railroads, the following items from the bashful and silent Heller, of Messrs. Heller & Brightly, are offered:

"We found 33 North seventh street too small for us; we therefore purchased the four-story building at the southeast corner of Ridge Avenue and Spring Garden streets, making special arrangements for the delicate operations of graduating and adjusting of field instruments. As to business proper, the railroad boom has struck us badly, the Mexican railroad surveys especially almost devouring field instruments; we having literally sent them instruments for the last eighteen months by the hundred. Last January we had orders on our books for 310 transits and levels, and had refused more orders than we had accepted. We were therefore compelled to issue a notice that we could not accept any more orders for some months; in June we again put forth a similar notice, and the same state of affairs exists at the present time, our unfilled orders to-day (Dec. 7, 1881) amounting to 180 transits and levels."

AS the season for renewal of subscriptions comes on, inquiries as to the rates of clubbing with other journals begin to be made. In reply we beg leave to state that we will pursue the same liberal policy that has always characterized the financial management of ENGINEERING NEWS. We will give to our subscribers *all* the discount allowed to us by other publishers, less five cents on each subscription, which we use to cover the expenses of attending to the business. The Harpers' and Century Company's publications will be the same as heretofore, and the increasing excellence of these magazines are too well known to need our indorsement. On class publications we must await the bills of the publishers; the average discount is 20 per cent. on new subscriptions; the *Sanitary Engineer* is 10 per cent.; the discount on renewals of the *Railroad Gazette* will hardly pay the cost of transmitting it, and the publishers are very loth indeed to accept renewals through outside parties. The best we can do is to do the best we can, which, as our patrons are well aware, is the principle upon which we are striving to serve them now and always.

WE notice in the *Railway Age* what the editor calls "an admirable method of developing information and directing thought to matters which may have attracted little consideration," viz., an order issued by the Chief Engineer of the N. Y., P. & O. Railroad, requiring each of the road masters on that road to have a written report, or answer to three of seventeen questions, on practical matters connected with their daily duties, embracing their individual views in reference to principles of construction on railroads, to be delivered and discussed at their annual meeting—nine were present.

Now with all due deference to the better judgment of the Chief Engineer, we should say that this was a step in the wrong direction. Let your road masters read as much as they can find time for from their most important daily duties on the road; but for Heaven's sake, do not stimulate or encourage a taste for writing.

It is the tendency of the day, and a most unfortunate one, to rush into print with matters so purely practical that the *truly* practical man would find it extremely difficult in putting them on paper. We have known road masters, and road masters whom we could ill spare, who would be incapacitated for their real duties while in the throes of birth of such productions; and, we must confess, that we should travel with some misgivings of safety on a road where we knew the road masters (as we understand their duties) were encouraged to strive for excellence in the preparation of written reports. The emulation thus incited might improve their style of composition, but it might be at the expense of other and more valuable improvement of their time in their responsible sphere of duty.

THE AMERICAN IRON MARKETS point in the direction of higher prices. With a few exceptions there is less probability of importations than for months. The cause is found in the steady upward tendency of the British markets. The occasion for this favorable condition is in a steadily improving continental and colonial demand, which absorbs current production and piles up orders for future execution. Foreign productive capacity is barely equal to demand. Enormous public works are projected on the continent; railway building on a large scale has been undertaken; the same is true of several of the British dependencies, notably Australia and Canada. Local requirements have assumed formidable proportions, and inquiries are pouring in for 1882. The activity in iron making is phenomenal. The efforts being made to meet the demand are on a scale of magnitude which requires only the factor of time to equalize supply and demand. There is no absolute scarcity in any department, but consumers felt it necessary to secure themselves by orders extending from two to twelve months ahead.

Prices are as high as it is safe for them to go without a further advance abroad. Very recent cablegrams point out the probability of such an advance. Still, it is not safe to rely on appearances. The British market takes very sudden changes, and that, too, without warning. Importers are still negotiating for supplies of bar iron, sheet blooms, plate and rails, new and old, but with very indifferent success, because of the firmness of prices abroad, the high ocean rates and the scarcity of material.

Within a few days large contracts have been placed for Bessemer, pig and blooms. Southwestern buyers have placed orders for steel rails. German makers have been applied to because of the oversold condition of British markets. Our steel rail mills are accepting a few orders at $60. The iron mills expect to turn on to steel blooms and thus, in a measure, compensate for the lack of converter capacity. It is evident that much of the consumptive demand which must be met before June will be obliged to seek European sources. A higher range of prices is quite probable. English mills are sold through the winter.

The rolling-mills are unable to meet all the demand presented. New boiling furnaces are being erected in a score of mills. Works making rolling-mill machinery are crowded with orders. The rolling-mill capacity will be very largely increased during the winter. Prices of iron are as follows: For finished, 2.6@3c., according to mill; structural

iron, 3@3¼c. to 4@4¼c.; plate iron, 3¼c. These quotations are generally adhered to. Railroad, ship, engine and car builders have entered into spring contracts during the past ten days in both Eastern and Western mills for large supplies of iron.

The enormous consumption raises apprehensions that productive capacity will be unequal to the demand, but these fears have very slender foundation when we survey the entire field. A temporary advance is possible, in fact probable, due to the disappointment, and a happy one to many, of heavy iron and steel importations. Foreign supplies on a large scale were somewhat confidently looked for. They did not come, nor will not, and hence the present strong upward tendency in prices. But productive enterprise is expanding capacity at a rate never before known to the iron trade. Ore and fuel will be cheapened by the development of mines and increase of transportation facilities. Hence, consumers should take no alarm at any sudden spurt in prices.

SEWERAGE OF AMERICAN CITIES AND TOWNS.*

As may be expected in this document [referring to Mr. Rawlinson's "Suggestions"], the latter engineer, with proper professional discretion, does not take sides with either of the so-called rival systems, nor even mention them as such. On page 3 of the "Suggestions" he says, very properly: "That main sewers must not be of capacity to contain flood water, as such floods should be passed over the surface, or by special channels," and "in large towns there may be exceptions, as in London, where flood-water overflow channels may have to be formed." The observance of this obvious principle is precisely the cause of the complaints in the working of the Providence and Brooklyn system of sewers, with the failure of the authorities to provide the needed storm overflows; it having formed no part of the original scheme of sewering these cities to provide in the sewers proper for the excessive storms which visit the coast at intervals, and at the epochs of high tide.

Again, on page 7 of Mr. Rawlinson's "Suggestions," he states that duplicate systems of sewers are seldom required, and then proceeds to show "that if constructed, they would lead to complications tending to defeat the proposed uses." And while we may have been in error, nothing to which we have had access favors the idea that Mr. Rawlinson has ever been the advocate of the separate system, but as Mr. Latrobe states, he undoubtedly "recognized its claims to intelligent consideration." Mr. L. further truly states "that the prevalence of the combined system does not grow out of an original design, having in view the best system it was possible to devise, but to the relief of already existing systems of combined sewers, which had become nuisances."

After describing the Memphis system of small pipe mains, a population of 35,000, with twenty miles of sewer, with flushing tanks at the heads of the branches one hundred and twenty-five in number (the latter machines, by the way, paying a royalty of near twenty-five per cent. on the cost), he states that "the storm water can safely be left to take care of itself." And here we would say, in passing, that however admirable this disposal of the rain water might be in an unpaved city of the size, shape and character of subsoil of Memphis, it would prove an intolerable nuisance on the crowded Northern paved thoroughfares, and impervious subsoil of many of our cities.

The defects in the working of the Memphis system are then adverted to, but with an obvious leaning toward a charitable construction of their defects, as when he states that the population used about double the amount of water originally estimated for, "which filled the mains and occasioned a backing up of the sewage in the lower part of the city," and adds, "this fault of course was not incident, at all, to the system, but was an oversight in proportioning the mains, and would not be felt during an ordinary winter." If the mains are not liable to being choked or overcharged in the extension of the separate system, we have been greatly in error, and when convinced of it shall hasten to rectify it, but the fact of the actual consumption of water exceeding the estimated consumption, as shown in this case, and through this excess the sewage was backed into the houses, shows pretty clearly that the system offers no better compensation for irregularities of flow, so likely to arise in our growing cities, than is offered by the combined system. After satisfying himself of the working of the Memphis sewers, the Brooklyn and Providence systems were examined, but the facts in all cases are not given with sufficient care. For instance, in alluding to the infrequency of the man-holes in the line of the Brooklyn sewers, it is stated that they are built at intervals of "five hundred feet or more," whereas they were designed to be at intervals of one hundred feet, and except in storm sewers, or sewers of very large capacity, such as occur but seldom, they are built as designed, viz., at one hundred feet intervals, and the statements of the defects in the working of the system are somewhat exaggerated. The system was designed to provide for one inch of rain falling in an hour. As the pavements increased in area of course such storms as exceeded that amount, not being provided for, have given occasion for complaint.

Brooklyn, with a population of 560,000, has three hundred miles of sewers; about two-thirds are of pipe, and the remaining third of brick, the largest of the latter being equivalent to a circle of ten feet; and with eighteen outlets into the East River.

Providence, with a population of 100,000, has twenty-eight miles of pipe sewer, and fifteen and a quarter miles of brick, the largest of the latter being sixty-six-inch diameter, and with sixteen outlets into river and harbor.

The provision for carrying off rain-fall is the same in both; and the same difficulty appears, when, as in Brooklyn, the rain-fall occurring at high water, exceeds the amount to which the best judgment brought to bear on the subject has hitherto restricted the capacity of the sewers.

Having taken these two cities as representing the best practice of the "combined system," the necessities of Baltimore are then considered as follows:

Taking the population to be provided for in Baltimore at 500,000, with a water supply of 75 gallons per head, he arrives at 5,000,000 cubic feet in twenty-four hours, and with a minimum grade of $\frac{1}{1000}$, and disregarding entirely any accession to the sewers of rain water from street, areas or roofs, provides an outfall sewer of five feet in diameter, and recommends the Memphis system of small sewers, restricted to the discharge solely of house sewage, by which we understand in bulk, the water supply.

Proceeding to determine the anticipated quality of this sewage, with a view to the determination of the suspended solids delivered daily at the outlet, he procured some bottles of Memphis sewage from the main outfall of that city for analysis, and finds 129 parts of solid matter in 100,000 parts by weight, 114 of which are in suspension, and 15 in solution; and as the Memphis water supply was taken at 40 gallons per head, and the Baltimore supply is estimated at 75 gallons, the extra dilution will be in the same proportion, and the suspended solids in an inverse proportion, or a total, by this method of computation, of 100 tons of solids daily; and then, subtracting the oxidizable portion, of about 8 per cent., he arrives at 92 tons of solids at the outfall for twenty-four hours.

It is true that the analysis upon which this rests is open to more than suspicion of its accuracy, as shown by the analysis of English water-closet town sewage, which he fairly quotes; but it appears that American, or rather Western sewage is somewhat a peculiar product, as it is stated that in the precious case in which the specimens were transported "one bottle had broken and saturated the sawdust, and yet there was no perceptible odor when the box was opened," and yet the entire computation for Baltimore is predicated upon these samples of inodorless sewage from Memphis representing the average discharge from a population of 500,000.

Mr. Corfield is then quoted in favor of the irrigative method of utilizing sewage, but disregarding the varied circumstances and limited scale upon which sewage farms have hitherto proved at all successful, the system is recommended as likely to produce a considerable revenue to the city of Baltimore. Taken in connection with the provision of three pumping stations, one of four million, one of six million, and one of sixteen million gallons daily, we can only say that if the city of Baltimore ever realizes one dollar for the sale of her sewage, on the scale proposed, it will be that the experience of the past is no guide for the future; although, we will admit, that a certain proportion of the sewage may be found profitable—to the individuals using it, but not to the city taxpayers—and yet this fact should by no means be taken as an evidence that, in a sanitary point of view, the system proposed may not be a success; but we object to holding out the profitable pecuniary return of the enterprise to the taxpayers as an inducement toward the introduction of the system.

We quote from a scientific contemporary of the first standing in England as follows:

"To dispose of sewage at a profit has been tried over and over again with the utmost persistency and at an enormous cost. The result has been a complete failure. In certain isolated cases, where the quantity to be dealt with has been small, or where the conditions have been exceptionably favorable, a small profit has been made either by individuals, companies or towns, but all attempts to get rid of the sewage of cities, and to realize for these cities even a moderate profit on the cost of the necessary works as well, have been failures."

The estimated cost of the proposed works is $3,200,000, and we give it as it appears in the report, but a million or two more or less should have no weight in the selection of a proper system for a city which has such a future as Baltimore.

In the case of the city of Stillwater, the population is not stated, but the plan proposes nineteen and a half miles of small pipes, avowedly in imitation of Memphis, but in addition, for good reasons, viz., a hilly site, with rapid discharges, four miles of "combined" sewer is added—to carry off the rain-fall from an inch of rain in the hour—making altogether about the same extent of sewer as in Memphis; and we notice it as an illustration of the possible danger of generalizing from a few particulars. The site would appear to be hilly and broken up by steep ravines, and where the effects of heavy rains are said to have worked mischief heretofore; and yet, from the *presumed* success of the Memphis scheme, the same, or similar, method of sewering the city is recommended, with the addition of a few miles of combined sewer of house sewage and surface water.

We are reminded here of an anecdote which has its application to hasty generalizations. The owner of a sick horse, inquiring of a friend whom he knew had had a horse under treatment, "What did you give your horse, Jones, when he was sick?" Jones answered that he "gave him turpentine," which answer, satisfying the querist, he administered the same to his horse, with a fatal result. Meeting his friend Jones sometime after, he told him that he had given his horse turpentine, "and

* *Reviews of Sewerage Reports, continued from page 487.*

it killed him." "So it did mine," responded Jones.

The sewers proposed for Elmira, in this State, are on the combined system, but the rain-fall for which the sewers are proportioned is estimated as one-quarter inch in an hour, to run off in three hours, which amounts to five cubic feet per minute per acre, and during eight hours of maximum flow, the house sewage, with water supply of sixty gallons per head daily, is estimated to furnish one-quarter cubic feet per acre per minute, but is not regarded as requiring any additional capacity in the sewers, if they are estimated as running but two-thirds full with the rain-fall. The population is assumed as reaching twenty-eight individuals per acre, or eighteen thousand to the square mile. The present total population is about 25,000. The effort is to be made here to admit no more rain into the street basins than the sewers can carry off. Sewers to be ventilated by perforated man-hole covers, and untrapped basin shoots, and untrapped house drain and rain-water pipes.

(TO BE CONTINUED.)

BOOK NOTICE.

"Mills' Directory of Boiler Owners and Steam Users for New York and New Jersey." The J. N. Mills Publishing Company. 208 pp. 1881.

As the above title implies, this work consists of an accurately compiled list of the boiler owners and steam users of New York and New Jersey. In order to obtain absolutely reliable information, the publishers state that their agents visited the various towns and cities to carefully collect the names, occupations and addresses of all using steam. The work is alphabetically arranged, first by cities, then by names, and after each name is given the number of boilers used. It is of great use as a book of reference to all dealers in and manufacturers of steam engines and pumps, gauges, valves, pipes, injectors, etc.; boilers, grate bars, boiler covering, etc. The book is neatly and strongly bound.

EAST RIVER BRIDGE.

A communication was received by the trustees of this work from the chief engineer in response to the resolutions of the board of trustees some time since, to the following effect:

"*Resolved*, First—That the chief engineer be requested to explain the increase of 1,000 tons of weight in the iron and steel required under the contract with the Edge Moor Iron Company.

"Second—That he report whether he approved of such increase when made and still approves of it.

"Third—Whether the increased weight will affect the safety of the bridge or its distance above the water.

"Fourth—Whether the bridge, after this increase of weight, will be able to carry a Pullman parlor car or an ordinary elevated railroad train.

"Fifth—That he be requested to explain the change in the appropriations for the work, by which the cost was largely increased as claimed by the Edge Moor Iron Company, the reasons for such change and the total amount of increase of cost.

"CHIEF ENGINEER ROEBLING'S EXPLANATION.

"BROOKLYN, Dec. 1, 1881.

"*Hon. Henry C. Murphy, President of the Board of Trustees of New York and Brooklyn Bridge:*

"DEAR SIR: I beg to submit the following remarks in reply to the resolutions passed by the trustees at the October meeting of the board:

"The increase of 1,000 tons arose as follows: The change from iron to steel was forced through in such haste (less than three weeks) there was no time to calculate every part exactly. No less than 600 drawings had to be made for that and the last one has just been finished. The weights in iron were largely taken as a basis of calculation, but they proved fallacious. It was expected that steel would give us from 15 to 20 per cent. more strength than iron, and that it would weigh from 12 to 15 per cent. less, but actual experiment proved that we gained the strength, but the superstructure was actually heavier because the steel could not be rolled as thin as iron. This bridge is so large and has so many parts that the thickness of a shaving on all the parts would amount to several hundred tons. In reality 500 tons of the extra steel now called for should have been included in the original specifications, if not a single alteration or addition had been made to the original plans; 300 tons increase are due to full rolling and greater specific gravity of the steel than samples furnished. For instance, every floor beam weighs 450 lbs. more than calculated, 900 tons were added when I reduced the number of sizes of channels so as to enable the Edge Moor Iron Company to get through at all with their limited rolling facilities. The remaining 100 tons were added by reason of necessary minor additions and changes. The following changes have been made in the original plans of the superstructure. The first by the late John A. Roebling in the spring of 1869. It became apparent at an early day that, owing to the length and exposure of the bridge, three sidewalks would be unnecessary, so two were converted into roadways for vehicles by adding five feet to the width of the bridge. This increases the moving and dead load in the main span each 135 tons, and the total dead load 260 tons. This was provided for in the cables and anchorages, and partly so in the towers. Next, the order of the Secretary of War requiring five feet more head-room under the bridge had to be complied with, either by raising the grade five feet or by cutting five feet off the trusses below the floor. It was decided not to raise the grade, which was steep enough already, but to raise the trusses above the floor, as the least of two evils, and yet it was a matter of regret to be obliged to do it, because the first position was the most effective, the lightest and cheapest. This raising has led directly to most of the subsequent additions. Five years ago, when I made the calculations for the height of the cables above the water, I deemed it prudent to allow one foot for increased deflection, due to any extra weight that might in the future be added. This, under the circumstances, has proved just right, and the bridge when completed will fulfill all the requirements of the law as to height above water. Margins of safety, or, in other words, the ratio of the maximum load that may be borne by a structure to the ultimate strength of its various parts, vary all the way from three to eight, according to circumstances. The margin of safety in this bridge is still over four, which I consider safe.

"Commissioners recommended three for the Blackwell's Island bridge, while Mr. T. C. Clarke thinks eight not too much for ordinary railroad bridges. As a general thing, the greater the dead weight of a bridge in proportion to the moving load, the smaller the margins of safety can be. Nine-tenths of the bridges in the country have a margin of between four and five. In the anchorages, where we have to provide simply against the upward pull of the chains, the margin of safety is two and one half times. In case of the cables, however, we have to provide for numerous contingencies which cannot occur in the anchorages. For instance, allowance must be made for the deterioration of the wire by the elements, for many possible imperfections in the manufacture of the cables, for any increase of weight or strain over that first contemplated, and, lastly, a certain margin is required, so as not to strain the wire beyond its limit of elasticity. The deterioration of the wire by the elements is remote. Our cables have been made with such care, the dangers of imperfect manufacture have been practically eliminated. The anticipated increase in weight has taken place. I consider the margin of the cables as great as that of the towers. The anchorages have been sufficiently reinforced. The extra weight of 1,200 tons, which seems to have alarmed some, is in itself not so terrible; 500 tons of it comes on the main span, or 125 tons per cable, producing a strain of 200 tons on each cable. As the cable has a strength of 12,000 tons, this increase is not alarming. Twelve hundred of the total weight of steel comes within 100 ft. of the towers. None of this is supported by the cables, because the suspenders will be slacked off. Most of this rests on the connecting-wall by reason of the truss acting like a cantilever, and a small portion is supported by the stays. A good part of the weight beyond the 100 ft. is further supported by the stays. I said before, the margin of safety is over four. Even were it possible for the 1,200 tons to come all on the cable, the margin would still be over three and one-half, with the thermometer at zero, when the deflection of the cable is a minimum, and the temperature strains in the trusses a maximum. The strength of one cable is taken at only 12,000 tons, while Colonel Pain claims it is really 12,300 tons. This will increase the margin of safety above mentioned. As the elastic limit of straight tempered wire is considerable higher than that of ordinary wire, namely, 66 per cent., instead of 50 per cent., the margin of safety when referred to the elastic standard is over 2.64. In one respect an error of judgment has, perhaps, been committed. It was somewhat uncertain at first how high the steel could be taxed, so it was deemed best not to strain it beyond 15,000 pounds per square inch. I now think we could just as well have taken it at 20,000 pounds, which would have saved ten per cent. in the total weight of steel, but as an offset to this we have the steel in the superstructure, which is that stronger and will last so much longer. Even at 15,000 pounds some sections came out so thin they had to be thickened to keep them from rusting. All that I ever assigned to the supporting power of stays and connecting walls is one-fifth of the total weight of the superstructure. The bridge can carry a Pullman car or any ordinary elevated railroad train. The railroad track will bear at the rate of one ton per foot run, while the trusses have ample distributing power. In 1878, while the working drawings and specifications for the superstructure were being prepared, an agitation was begun to force the use of locomotives on the bridge. I did not approve of them on account of the grade and because they would pass so near the horses on the roadway as to greatly interfere with the carriage traffic across the bridge, and on account of the bridge not being strong enough to carry them. My objections were fully stated at the time by reports and numerous letters. Fearing that they might be used, in spite of all my opposition to them, I deepened and strengthened the floor-beams and put in an intermediate floor-beam. I also found that by adding one hundred tons to the main span I could raise the intermediate trusses to the level of the middle ones and make a cross connection on top, and thereby double the efficiency and yet leave head-room enough for elevated trains. It would have been well if we had stopped here, but it was discovered that a Pullman car had not head-room by nearly three feet. I held out for three months against this change, but in vain, and two hundred tons were again added to the main span, because all four middle trusses had to be raised, while the posts required extra bracing; most of this weight comes on the middle pair of cables which, from their position, have a little more to bear than the outer cables. We will now have a bridge so rigid that the ordinary daily traffic will have no visible effect on it.

"Respectfully yours, W. A. ROEBLING."

We think Mr. Roebling's statement requires very little explanation, so far as his individual responsibility for any changes made was involved.

It is not at all likely that any changes were made by him, involving additional expense, after months of persistent opposition to such changes on his part, unless by authority which he recognized as competent.

What that authority was, we may never know precisely, but, as a step in the right direction, possibly, we quote the answer of Mr. Stranahan to a remark of Mr. Roosevelt, "that he should like to hear some explanation of the statement of the chief engineer that he held out for three months against the alteration. I want to know who compelled him to make that change, as I have not heard that the board took any action in the matter.

"Mr. Stranahan—It occurred in this manner: There was a desire felt to have a bridge sufficiently strong and with a capacity equal to the passage over it of a Pullman palace car, or of a train of elevated railroad cars. A committee was appointed on the suggestion of Mr Haswell, who was then a member of the committee and felt in common with the other members of the committee, that the bridge should be equal to the passage of a Pullman car. We consulted with the engineer as to how that thing could be done, and learned that it only required that the trusses be made higher, or the brace across the top of the truss should have a bow in it, if you please to call it so, and it was thought by Mr. Roebling that it would be better to increase the height of the truss. I had no idea it would increase the weight of the bridge the 200 tons. I had no reason to think it would increase that amount, although I knew there would be an increase. Those are the facts. And now for my share of the responsibility. I am glad the thing was done, and I think every member of the board may rejoice in the fact that the capacity of the bridge is now equal to the passage of any train of cars that may pass over any of the roads in the country."

This statement was not satisfactory to Mr. Bush, who was in search of "authority" for the change made, having been assured that no resolution was adopted authorizing it, and that no committee had been appointed for the purpose of increasing the weight of the bridge. Mr. Stranahan's reply to this was, "that the report (presumably of the committee) was a written report, and had the approval of our board, and is on the minutes."

Here Mr. Trustee Roosevelt appears again in the same rôle we had occasion to comment upon in an article of the 19th of November; and it would look at first sight, that this patriotic New Yorker deplored the action of trustees and engineer in adding to the weight of structure, by *raising the height of the steel trusses, and thereby providing for Pullman and freight cars, draining the resources of the city of New York, and fertilizing the sandy plains of Long Island!* We quote him:

"Mr. Roosevelt—I met Mr. Charles H. Haswell, and asked him about this matter. He said he had never taken any action in regard to increasing the weight of the bridge, and was very much surprised that it had been done. It is possible, however, that both Mr. Stranahan and Mr. Haswell are mistaken. This is a very serious matter, as the board has placed entire confidence in the president, the vice-president, Mr. Stranahan and the Executive Committee, and although he did not say that confidence had been in any way misplaced, he thought it should be respected. The bridge will not only carry the Pullman cars, but will also carry freight trains; and if that was done, although it might benefit Brooklyn, it would add very much to the embarrassment already experienced in the crowded streets of New York. Then it will take trade away from New York and give it to Brooklyn; and it was a question that had to be settled whether the New York members were willing that should be done. He for one was not."

The thing is done, however, and we are in ignorance as to whom to thank for the fact that, between the trustees and the engineer, they have built better than they knew, and the effort by resolution of Mr. Roosevelt, to forbid for all time

the passage of the bridge by freight trains was properly disposed of, and the public may rest assured that, when finished, the bridge will be used to its fullest capacity, which, so far from being lessened by the changes made, has been increased thereby fully 20 per cent.

We append the following official statement of cost:

Statement of the Financial Condition of the New York and Brooklyn Bridge on the 30th Day of November, 1880.

CASH RECEIPTS.

From the City of New York prior to June 9, 1875	$1,500,000.00
Under the act of May 14, 1875	2,421,900.00
Under the act of April 7, 1880	516,000.00
From the City of Brooklyn prior to June 9, 1875	3,000,000.00
Under the act of May 14, 1875	4,523,693.73
Under the act of April 7, 1880	1,033,333.33
For rent	185,882.33
Interest	50,852.43
Horses and harness sold	7,759.00
Wharfage	4,800.01
Materials sold	85,272.30
Scows sold	6,469.00
	$13,836,962.13

CASH EXPENDITURES.

For engineering, salaries, etc	$452,043.21
Office expenses, salaries, etc	152,758.07
Timber and lumber	445,647.05
Construction	2,299,834.51
Contingent expenses	65,955.95
Rent	75,620.85
Tools	20,104.83
Labor	2,189,556.96
Machinery	136,903.38
Freight, cartage and towage	35,038.65
Printing and advertising	12,571.41
Land, land damages and buildings	3,702,734.38
Limestone	608,041.37
Interest and discount	171,099.38
Horses, wagons and harness	19,963.33
Cast steel cable wire	623,733.19
Insurance	8,982.13
Granite	2,115,903.17
Loss on New York City 6 per cent. bonds	9,236.62
Loss on New York City 7 per cent. bonds	3,509.18
Taxes and assessments	6,068.27
Scows and repairs	31,008.36
Office furniture	6,216.77
Freight on account Collins Granite Company	435.31
Total	$13,323,155.68
Expended prior to June 9, 1875	5,388,646.06
Expended since June 9, 1875	7,934,509.62
Total	$13,323,155.68
Cash in Atlantic State Bank	12,224.83
Cash on hand in petty cash	581.62
Total	$12,806.45

CASH LIABILITIES.

Booth Bros	1,536.48
The J. A. Roebling's Sons Co	7,297.43
Edge Moor Iron Co	31,283.09
Cofrode & Saylor	4,298.01
Eppinger & Russell	1,596.18
Abbott Pavement Co	576.18
Edmund R. Andrews	664.55
Otto Lachenmeyer	100.16
Salaries for November	3,905.15
Percentage retained on materials received in November	3,544.44
Total	$95,846.61

NEW FRENCH AND ITALIAN METHODS OF GEODESY.

In our issue of Oct. 15 we gave illustrations of novelties in engineering instruments exhibited at Milan. The kind of theodolite invented by Professor Porro, and to which the name of tacheometer has been given on account of the facility it affords for logarithm tables and the great rapidity with which geodetical operations can be performed, has found some warm defenders, while some engineers think that there are other and better methods for attaining the results aimed at. For the better understanding of the subject we repeat the illustration of the instrument in question. The verniers are divided into 4,000 parts. Fig. 1, a smaller model in which thev erniers are divided into 2,000 parts, is represented in fig. 2.

M. Kazimirski, who is chief engineer of Seudre France) Railway Company, wrote a long criticism on the Porro system in the *Génie Civil*, at the same time offering a remedy of his own. His letter found in turn a critic in M. Le Brun, chief engineer of the Isle of Reunion Railway. We translate both letters as containing subjects of interest to all engineers, and as matter calculated to evoke some criticism on the part of the profession in this country.

M. KAZIMIRSKI'S NEW METHOD FOR DRAWING MAPS AND TAKING LEVELS WITHOUT CHAIN WORK, OR TRIGONOMETRICAL CALCULATIONS.

A series of instruments has been devised for simplifying the preliminary surveys, for railway lines especially, but, despite the precision of those new apparatuses, we see operators always coming

FIG. 1.

back to the routine methods for the simple reason that these instruments are more theoretical than practical, and necessitate for their use an amount

FIG. 2.

of knowledge which is lacking in the majority of engineers.

The improved theodolite of M. Porro has been adopted by a few enthusiastic specialists, but during the last twenty-eight years it has not grown in favor, and it will never become an instrument within the reach of every engineer. I believe that it has had its time.

Important State works are to be executed; the net of French railroad is judged insufficient, and it is therefore of interest to curtail the time for laying out the new lines. It is with this view that I propose a method which requires only a few hours for its mastery, and, if it only serves as a point of departure for other improvements, I believe it is worth explaining.

THEORY OF THE INSTRUMENT.

The new method which is applicable to geodetical instruments, etc., does away with the difficult part of the indoor work; that is, the calculations that are required to find the distance of every point, the level of which has been taken from the foot of the instrument, and also the calculation of the altitudes. The apparatus can be easily used by engineers, who are discouraged at employing the tacheometer, at present in use. THERE IS NO CHAIN WORK IN THE FIELD, AND NO TRIGONOMETRY IN THE OFFICE. Such are the advantages of the new graduation, which can be applied to the theodolite, the tacheometer, or any other instrument used in geodesy.

On the line AB, supposed horizontal and one meter in length, let us raise the perpendicular BC, divided from B to C in centimeters (fig. 3). Let us consider the point A as a center, and join it to the points m n, etc. We have then directions Am and An, representing, with relation to the horizontal line AB, grades of 0.01 meter per meter, for Am; of 0.02 meter per meter for An, and so on, for the other points taken on BC, and distant 0.01 meter from one another.

If from the point A as a center, we describe a circumference with any radius and that on AB prolonged we take a length $AB' = AB$; that, at the point B' we raise a perpendicular $B'C'$, so as to repeat a symmetrical figure to that described, we shall have found the graduation of my circle by its cutting the lines Am, An, etc. *This circle, with those divisions which in the theodolite, for instance, will replace the vertical circle, divided into degrees, or equal angles* will enable us, when AB is horizontal, to set the eye-piece according to the known gradients or inclines of an analagous value when the division is *made below* AB.

Let us suppose that a leveling staff is placed at a certain distance, and that it can be seen with the eye-piece of the instrument and set horizontally.

Supposing that we read 1.457 meters. Let us then incline the eye-piece so as to read according to the gradient Am of 0.01 meters, we have, for instance, 3.369 meters. The difference between the two readings will enable us at once to ascertain the distance of the level from the foot of the staff, this difference being 1.912 meters. We say that the leveling staff is at 191.20 meters, and we have only to change the decimal two places to the right and do away with chain work.

It is very easy to see that if we had to take the sighting following any other direction than the

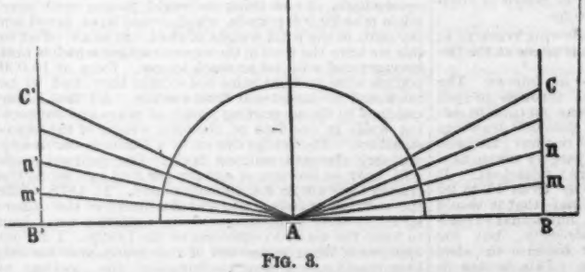


FIG. 3.

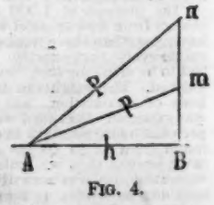


FIG. 4.

horizontal, which is peculiarly favorable, the work would be quite as simple on the condition of having two readings following to two contiguous inclines—that is, with gradients or inclines having no greater incline between one another than 0.01 m.

per meter. Here is the demonstration of the fact.

CALCULATING DISTANCES.

Let there be two lines passing through the point *A*, and situated on the same side as the horizontal line *AB* or *h*, and let them be cut at *n* and *m* by the perpendicular *Bn*.

Let us admit that the lines *Am* and *An* recede from the horizontal according to the inclines *p* and *p'*; that is, if *AB* were equal to 1 meter, *Bn* would be equal to *p*; or, to generalize the definition, that *Bn* would contain as many times *p* as *AB* will contain times 1 meter. This gives us:

$$Bn \text{ or } Bm + mn = h \times p'$$

on the one part, and

$$\frac{Bm}{mn} = \frac{h \times p'}{h(p-p')}$$

on the other part, whence

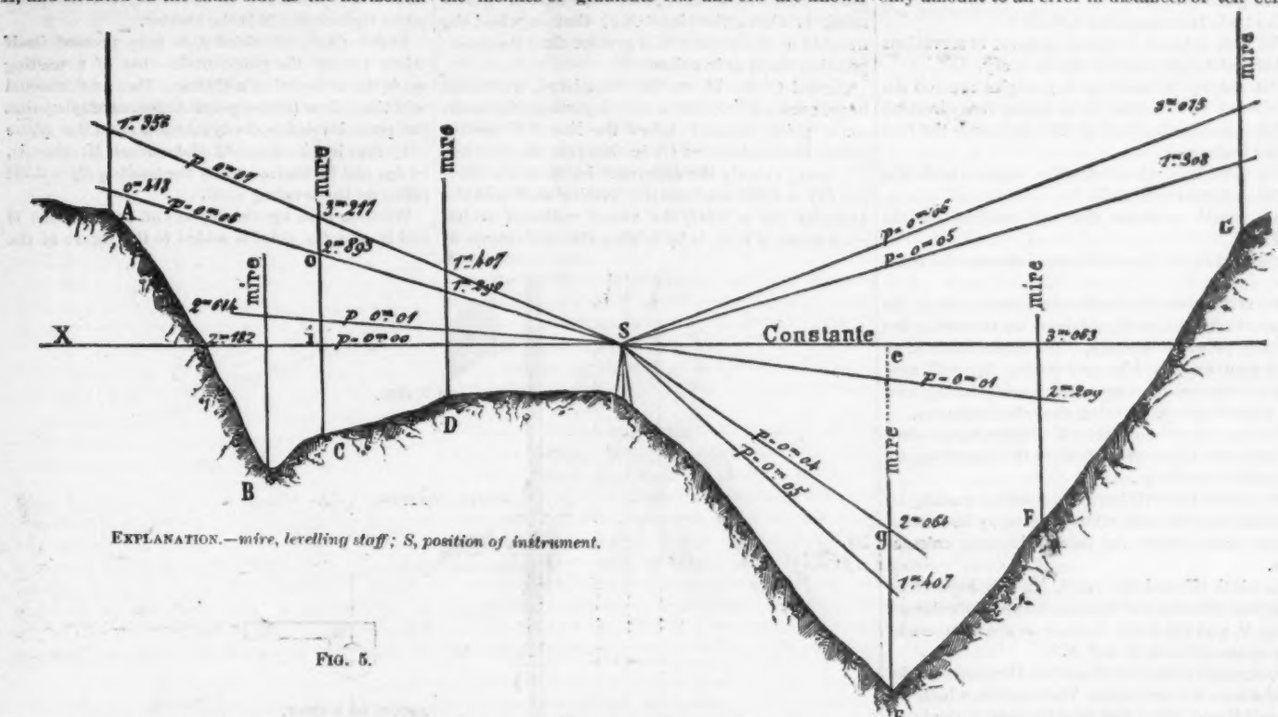
$$h = \frac{mn}{p-p'}$$

By subtracting the equalities member by member we have a third equality, and from them we arrive at the value of *h*, which proves that in the above figure, when we know *mn* and when the inclines or gradients *Am* and *An* are known (let us call them *p* and *p'*), we have, in order to find the height *h* of the triangle *nmA*, or rather to calculate the meeting point of the two slopes, only to divide *mn* by the sum of the inclines if they are in contrary directions, or by their difference, if they are, as in this case, in the same direction:

$$h = \frac{mn}{p-p'} = \frac{1.912}{0.01} = 191.20.$$

When the reading is always made following two contiguous slopes, the difference $p-p'$ is always equal to 0.01 meter, which causes us to move the decimal, as in the preceding case, two places to the right. It is in this way that the instrument enables us to do away with chain work.

As readings on the levelling staff can be appreciated to nearly one millimeter, it may be said that the chain figures are sufficiently near, as a difference of one millimeter on the staff would only amount to an error in distances of ten centimeters. We can therefore class this instrument among the exact apparatus.



EXPLANATION.—*mire, levelling staff; S, position of instrument.*

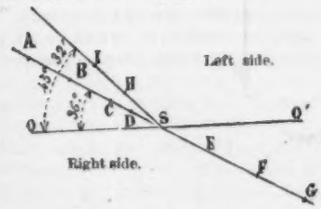
FIG. 5.

CALCULATION OF ALTITUDES.

In order to show the ease with which altitudes can be calculated by the new method, I have subjoined the profile model, which will serve to indicate the different cases which may be met with in the course of an observation. A table to be used for the leveling memorandum books is also subjoined.

The cut represents a station supposed to be at *S*, and the double reading made on the staff at the points *A*, *B*, *C*, *D*, *E*, *F* and *G* of any profile.

Arrangement of the Memorandum Book.—The memorandum table recommended by M. Moinot,

Points and Sketches.		Angle on horizontal plane	Declivities.	Reading on staff	Difference of readings.	Difference from staff to apparatus	Product of this difference by smallest declivity. M	Reading following smallest declivity. N	Sums and differences of columns M and N: Differences K	Sums L	Guide marks and true leveled points.	Horizontal plane X Y, or constant passing through axis of eye-piece.
1		2	3	4	5	6	7	8	9	10	11	12
	Mark *A*	30°	+ 0.07 + 0.06	back 1.356 0.418	0.938	93.80	5.628	0.418	− 5.210		48.206	42.996
	Mark *B*	36°	+ 0.01 0.00	2.614 2.182	0.432	43.20				− 2.182	40.814	
	Mark *C*	30°	+ 0.07 + 0.06	3.217 2.893	0.324	33.40	1.944	2.893	− 0.949		42.047	
	Mark *D*	30°	+ 0.07 + 0.06	1.407 1.290	0.117	11.70	0.702	1.290	− 0.588		42.408	
	Mark *E*	216°	− 0.04 − 0.05	2.064 1.407	0.657	65.70	2.628	2.064		− 4.692	38.304	
	Mark *F*	210°	0.00 − 0.01	3.063 2.209	0.854	85.40				− 3.063	39.933	
The line *OO'* is the base of the operation.	Mark *G*	210°	+ 0.06 + 0.05	3.015 1.308	1.707	170.70	8.535	1.308	+ 7.227		50.223	
Sub details:	Mark *H*	45° 39′	+ 0.10 + 0.11	0.894 1.052	0.158	15.80	1.580	0.894	+ 0.686		43.082	
30° + 180° = 210° For prolongation following *EG* of direction *AS*.	Mark *I*	45° 32	− 0.10 − 0.09	3.286 3.931	0.645	64.50	5.805	3.931		− 0.736	33.260	

T T'

To pass from one station to another, it is only necessary to draw the line TT', and the table can be used as at beginning.

Remark 1.—The signs + and − show how to pass from the constant of column 12 to the altitudes of column 11 by *adding* or *subtracting* the values in columns K and L.

Remark 2.—In calculating the constant, we operate according to the plus or minus sign of the figures of columns K and L, to pass from the mark column 11 to this constant, which is written in column 12.

Chief Engineer of the surveys of the Central Branch for the Orleans Co., is composed of 16 columns for the use of the tacheometer. There are only twelve columns in the new method for calculating the levels.

The table is arranged as follows:

The first column contains general observations and sketches for assisting the memory.

The second is reserved for angles read on the horizontal circle—that is, it gives the direction which connects the foot of the staff with the foot of the instrument.

The third is for the declivities from which the readings have been made.

The fourth contains the two readings on the staff.

The fifth is for the difference between the readings.

The sixth gives the horizontal distance from the apparatus to the staff, obtained by removing the decimal point or comma. The memorandum so far is kept exactly like any other. We will now see how we can do away with the calculating rule and trigonometry, by using the other columns.

The seventh column (*M*) will contain the product of the distance from the staff to the apparatus by the smaller declivity.

The eighth (*N*) will have the smallest reading on the staff repeated, and which is already in column 5, but here given for facilitating the calculations.

The ninth (*K*) and the tenth (*L*) will have: The ninth the difference of the numbers of the columns *M* and *N*, and the tenth the sum of the numbers of those same columns *M* and *N*.

The eleventh column will contain the guide-marks and the true leveled points. The twelfth, which we will call *the constant*, will give the side of the horizontal plane passing through the center of rotation of the eye-piece, and corresponding to the plane of sight in the Egault and Lenoir instruments.

Use of the Table.—The operator must understand the necessity of showing in column 3 of the sights the declivity on which every reading has been made, and the *positive* or *negative* sense of this sighting with relation to the horizontal plane *XY*, passing through the axis of rotation of the eye-piece. For this reason the numbers of the declivities must be preceded by the signs + or −, according to the case.

Column 6.—We know that to get the figures of this column we have only to multiply by 100, the corresponding figures of column 5 of the differences.

Calculation of the Altitudes.—It must be fully understood that the column M (see profile and table) represents the quantity of which the visual radius runs off vertically from the plane *XY* of the constant. We thus see at once that to calculate the altitudes, we must begin with that of the constant.

CALCULATION OF THE CONSTANT.

Let us begin at the beginning and consider the case of the back sight on the guide-mark *A*.

First Case.—The reading having been made by means of a positive sighting, that is to say, above the line *XY*, or by a negative sighting, that is, below it.

In our rough draft we will take the point *A* as our guide mark. Its altitude, 48.206, we know.

From what we have said the number 5,628 meters (column 7), shows that the visual radius meets the staff at 5.628 meters above *X Y*. Let us subtract 0.418 meters, and we have the distance 5.210 meters, which must be taken down from the guide-mark *A*, to get to the plane *XY*.

The figure of the plane *XY*, that is to say, of the constant, is therefore given by the difference between 48.206 meters of the mark, and the number 5.210 of column 9, or 42.996.

Remark.—It was to obtain this number, 5.210 meters, more easily that the reading 0.418 of column 4 was carried into column 8, or N, alongside column 7, or M, and that the sign—was placed before the number to indicate the required operation. This will be done every time that the guide-mark is above the plane *XY;* that is when the number in the column M is greater than its corresponding number in column N.

Second Case.—If, on the other hand, we should have, even with a positive sighting as a guide-mark, some point situated below the line *XY* (such a point, for instance, as *C*), in that case the distance *CI* being exactly the difference between the reading *CO* = 2.893, made on the leveling staff, and the quantity *IO* = 1.944, the visual radius of which rises above *XY*, it is by adding this difference to the figure of the guide *C* that we obtain the figure of *XY*.

From the look of the table, the reading (column 3) having on the one hand been positive, and the figure of the column M being smaller than that of column N on the other hand, we might conclude (see profile) that we had to deal with a point *below* the plane *XY*.

Our guide mark for point *C* would be	42.047
Let us add	0.949
And we have the constant	42.996

It may be stated, *en passant*, that in our table, as the point *A* is used as a mark, the point *C*, like the rest, forms a part in the same station of what we call the fore sights. I only adopted it in the preceding explanation for the purpose of analyzing the figures in the table.

It is shown, therefore, that when a back sight is taken with a positive sighting, the plane *XY* is always at a vertical distance from this point, which is equal to the difference of the figures in columns M and N, and that this plane *XY* is below the leveled point, when the side of the column M is greater than the corresponding one of column N, while the plane *XY* is above the leveled point when the column N is the greater.

Third Case.—A third case may present itself when taking the guide-mark—that of a reading made in a negative sighting. The profile model will then show (as per point *E*, for example,) that the point leveled is always distant from the plane *XY*, first by the value of the column M, that is, by *eg*, and furthermore, by the reading *Eg* = 2.064 taken on the leveling staff.

We then sum up the figures of the columns M and N and the total is added to the figure of the guide and we obtain the position of the plane of the constant, 4.692. Let us add the sum of the columns M and N to the true number of the point *E*, 38.303, and we have the constant again, 42.996, whence the rule:

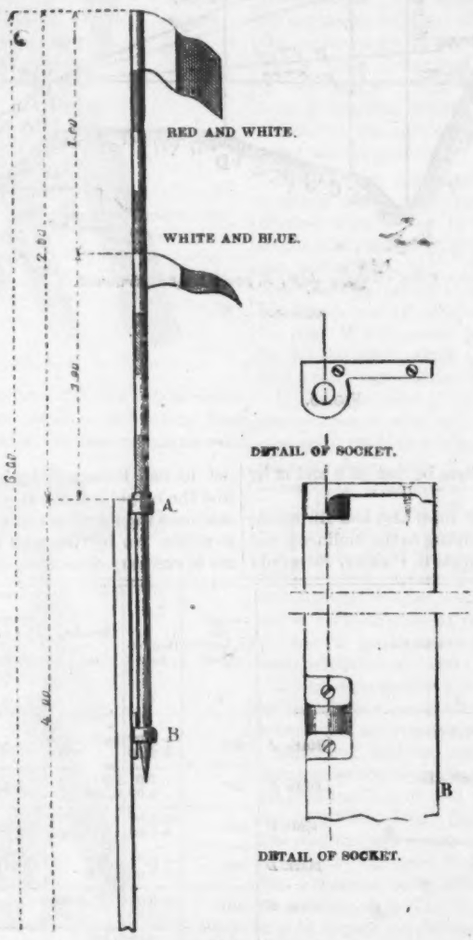


Fig. 6.

General Rule.—1. When the mark is perceived in a negative sighting, which is found indicated in column 3 of the inclines, the constant is obtained by adding the figure of the mark to the sum of the figures of columns M and N.

2. When the mark is perceived with a negative sighting, the difference between the figures of columns M and N is taken and added to the mark, when N is ⊏ M, and subtracted when M is ⊏ N.

Remark.—It must not be lost sight of that the signs + and — of columns K and L (ninth and tenth) of our table are not given for the purpose of calculating this constant, but in order to show how, with the constant, we can obtain the true height

and the leveled points by the addition or subtraction of the values in the columns.

CALCULATION OF THE LEVELED POINTS.

The constant once obtained, it is easy to calculate the other points by keeping in view the signs + or — of columns 9 and 10. The three cases which must be studied for fore sights are the following:

First Case—Where Points are Perceived by Means of Negative Sights—All these points are below the line *XY*, and at an equal distance from the sum of the columns M and N. The figures of

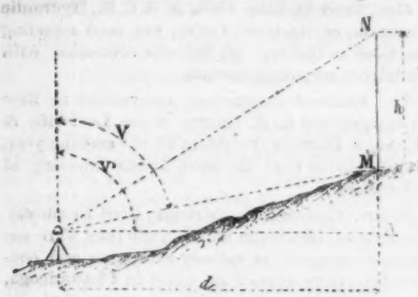


FIG. 7.

these columns will therefore be added and the sum written in column *L* (tenth) with the sign preceding the total, which will show that this value is to be deducted from the constant in order to obtain the figure of the leveled point (as in points *E* and *I* of the table). It may be incidentally observed that points *H* and *I* of our table (see sketch, column 1,) are leveled in another direction than that

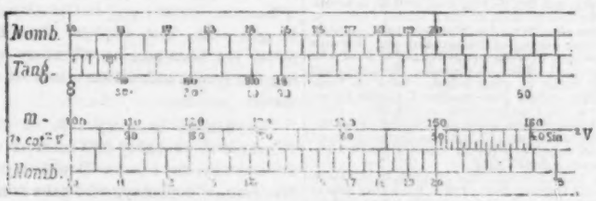


FIG. 8.

of the profile model, which is seen from the indication of the angle 43° 52′ of column No. 2.

Second and Third Cases—Points Perceived with Positive Sights, and which are Above XY, as Point G, or Below, as Point C—In these two cases we must make the subtraction of the two columns M

FIG. 9.

and N, since this difference (see profile) will always indicate how far the point is vertically distant from *XY*; but when the column M is greater than N, the point will be above *XY*. The difference found will be placed in column K (the ninth), with the sign + to prepare the addition of this figure with that of the constant.

In the case of point *C*, on the other hand, the greater value being column N, the difference will be taken, and written, preceded by the minus sign in column K, to facilitate the subtraction of 0.949 from the figure of the constant.

Remark.—We may add that the points perceived with the sighting at 0.00, or horizontal, as *B* and *F*, will follow the same method as for levelings made with the ordinary levels, and that their true figure will be obtained by deducting the reading of the horizontal sighting from the value of the constant. It is this reading, 2.182, preceded by the sign — which can be brought into the tenth column (L).

From the above we arrive at the following rule for calculating leveled points:

General Rule.—1. For all negative sightings add up the columns M and N, indicate the result with the sign — in column No. 10, or L, and subtract from the constant *XY*.

2. For all positive sightings, make the subtraction of the columns M and N, make use of the sign + for the result when M is greater than N and the sign — when N is the greater, inscribe these results in column K and finally add the + and subtract the — from the constant already found.

Remark.—It is seen that the calculation of the figures of column M will be much easier by make use of the horizontal sighting, and by taking in preference, as often as possible, readings from the declivities 0.10, 0.20, 0.30, etc., since in such cases the column M can be found by removing the decimal and by simply multiplying.

Observation.—At a distance of 100 meters two successive readings on contiguous declivities require a field on the staff of 1.00 meter. To use the instrument in the most unfavorable cases, as in a wood, where only 0.50 meter of the leveling staff can be perceived, it will be requisite to indicate the division of slopes of 0.005 metre.

Again, in this case, after taking the differences of the readings made on the leveling staff, we obtain the chain work by removing the decimal, but we must multiply the product obtained by two.

Let us return to the case already considered, and allowing that the directions of the sightings have followed declines, the difference between which was only 0.005 m. per meter.

We should then have for the distance by chaining, according to the formula:

$$\frac{3.360 - 1.457}{0.005} = \frac{1.912}{0.005} = 382.40$$

or

$$\frac{1.912 \times 2}{0.01} = 191.2 \times 2 = 382.40$$

In a word, after subtracting the two readings, remove decimal two places to the right, and multiply by two.

In this, as in the other cases, the altitudes will be calculated by the general rule.

All the work now performed by the tacheometer in use can be had by the new apparatus, or with theodolites and tacheometers on the new system, more rapid work can be done in some instances—the building of a dike on a river can be examined at any moment of the day.

Again, suppose we wish to send a staff man to plant a stake across a river and at 134.80 meters. He crosses the river and places the divided rule on the other bank. For the first trial, the operator takes two readings, and finds that the staff is only at 122.30 meters. He gives a sign and the man places the stake twelve or fifteen paces farther. Two new readings are taken, and the distance is found to be 132.60 meters. The staff man then measures 2.20 meters with the staff, and we have the distance required.

We find in the *Genié Civil* a very interesting letter from a civil engineer at Saint Denis (Reunion), which we translate as follows:

"Mr. Kasimyrski, in criticising the tacheometer Porro, says that this system has had its time and he proposes another. The remarks which he makes on the matter are certainly ingenious, but they refer to only a few special cases.

M. Moinot, in the first edition of his work on the subject, had unnecessarily complicated the question. Since then he has rectified this mistake, and his method must now be considered as the most rapid, economic and simple of all. I have taught it in a few hours to young men just from school and who, in a few days, became good operators. If they did not understand the theory at first, they knew at least the practical part. M. Kasimyrski only indicated, as it were, planimetry, and his system cannot differ much from that in general use, and if he suppresses trigonometry, he renounces at the same time to bring forward the highest summits of the survey to their rectangular co-ordinates, and thus deprives himself of one of the greatest advantages of tacheometry.

He replaces the ordinary graduation in degrees on the vertical circle by a graduation according to the tangent.

In the Field.—With his method for determining a point we must have two pointings, each according to the division of the limb, and which have been made beforehand. We must also have two readings on the limb, two readings on the leveling staff; and we have to take note if the sightings are above or below the horizon. With the old system, all we require is a single pointing on the best point of the leveling staff; two readings on the limb, two readings on the leveling staff—one of which can always be made on an exact number of yards. The use of zenith angles does away with the necessity of sighting. The advantages of the old system are: there is less work, two operations fewer, greater rapidity of reading and less risk of mistakes.

Calculations.—The method in question does away with the reduction of horison distances, and also with calculating rules.

One of the great advantages of the tacheometric system, in my opinion, is to have the calculating rule, which reduces the time for numerical calculations by two-thirds. If we admit its principle—calculating the reduction of distances, and multiplying by the tangent, and effected by a single movement of the rule—the time employed is the same in one case as in the other.

We thus see that the method presented to us has not as many merits as the old system. But it can be of great service when we have no calculating rule. But we should have not only the division in degrees on the instrument, but also the division according to the tangent, as is almost invariably the case with English instruments.

We must borrow two other improvements from them. They have their instruments furnished with everything necessary for making observations night and day. This facilitates operations in tunnels, gives the determination of the meridian, and of longitudes and latitudes. Their instruments are of a dark, green bronze, while our instrument makers still continue to give their instruments the best polish possible—a fact which gives a great deal of trouble when using them in hot countries. The instrument might also be profitably used in countries where no detailed map has been made, for distances over 700 meters—which is a superior

limit to that given by the stadia. Of course, we can arrive at the results by a triangulation, but this requires long calculations, and, moreover, it is not possible if the point we have to fix is only visible from a single station.

If this point is accessible, we send a man with a leveling staff, and if necessary with a directing staff of two meters, with which a height of six meters can be observed (Fig. 6).

This leveling staff being put up, we can observe the zenith angles V and V', Fig. 7. We have then:

$$d \cot. V = AN$$
$$d \cot. V' = AM$$

Whence

$$d (\cot. V - \cot. V') = AN - AM = h,$$

which gives the regular relation,

$$d = \frac{h}{\cot. V - \cot. V'}$$

which can be easily calculated by means of the common trigonometrical tables. But it can be calculated as easily by means of the rule. We see, in fact, that

$$\cot. (V - V') = \frac{1 + \cot. V \cot. V'}{\cot. V' - \cot. V}$$

and consequently

$$\frac{\cot. V - \cot. V}{\cot. (V - V')} = 1 + \cot. V \cot. V$$

Observing at the same time that there are only a few minutes difference between V and V', we can say

$$\cot. V \cot. V' = \cot.^2 \frac{V + V'}{2}$$

and placing

$$V' - V = \delta,$$

the formula will become

$$d = \frac{h \cot. \delta}{\cot.^2 \frac{V + V'}{2}}$$

adding, moreover,

$$1 + \cot.^2 \frac{V + V'}{2} = m$$

we have

$$d = h \frac{\cot \delta}{m}$$

a formula which can be easily calculated by the rule. To do this, we have to draw on the line of the lower part of the rule, which has the square sinus, the values of m, which correspond to the different values of V, comprised between the ordinary limits of vision, 50 and 150 degrees (Fig. 8.)

As the tacheometer gives angles to a centesimal minute to (0,01°), we see that, with a leveling staff of 6 meters and a vision between 70 and 130 degrees, we can have an approximation of at least 5 per cent. of the total distance as far as 2,000 meters.

If the point is not accessible, or if the distance is further than 2,000 meters, the method is, however, at fault; but if, as Mr. Porro proposes, we add a trismatic square to the tacheometer, we can measure distances up to 8 or 10 kilometers.

Let us suppose that this instrument in A (Fig. 9) be $AB = l$ the distance to be estimated. We have then to find out by the square a point C, so that the angle ACB be a right angle, which can be made very approximately if the square has a good sight. We then mark the point C with a directing staff, we measure the angle α, the distance d to the middle of the stadia, and we have in the rectangle triangle ABC

$$l = \frac{d}{\cos. \alpha}$$

The base d should have the greatest possible length—if we give it from 25 to 30 meters we can judge distances from 8 to 10 kilometers.

This system enables us to draw up plans for railroads, etc., in a country for a radius of about 10 kilometers, with a satisfactory approximation, and at the same time have a tolerably good map of the country.

HIS ANNUAL RAMPAGE.

We cannot forbear quoting at some length an extract from a late report of Chevalier C. Baillairgé, Chief Engineer of the City of Quebec, on the "Amelioration of its Aqueduct," as illustrating a line from Horace, "Cœlum, non animum, mutant qui trans mare currunt," and the boldness of a city official in exposing the truth of what most of us have seen elsewhere, and but few have had the courage thus to express.

"Occupy the attention of the City Council with the advisability, or the contrary, of retaining 15 days of a man's salary, a miserable $25 from an employé of 36 years standing, who had grown gray in the city service, half a month's salary for having had to lay up after getting badly beaten by a lot of rowdies, while on the contrary it is he who has an undoubted right of action for damages against the city whose police on that occasion and every other is, from want of numerical force, powerless to do the needful.

"Discuss the advisability of a coal-oil lantern in an unfrequented and dangerous locality; that of an expenditure of $7 in relation to the band of the French frigate, and God only knows what else of a like nature.

"Oh! it is not singular, gentlemen, that the public should be indignant, as they justly are, and threaten the very existence of an institution capable of occupying its deliberations with measures of like importance.

"The public does not want this, the cutting down of the charwoman's wages by 10 cents, those of the fire wood purveyor by 20 cents. Refuse to pay a party his just due and then pay capital and costs together. Capital and costs in a hundred pending suits against the city for injury to life and limb of man and beast, injury to vehicles, because you will persist in believing, or affecting to believe and trying to impress the public with the fact, that a corporation employé can do the work of ten men in other cities. I must stop, for God only knows what I might not add under the legitimate indignation I feel while contemplating a mal-administration, which, if it did exist previously to 1880, has but increased and since become more marked, more accentuated, and has at last attained its apogee under the pretended reformers of the municipal concern, elected by an intelligent ward of the city which has been led astray by the false representations of one man in particular, he of whom one of the judges of the —— Court, as good a physiognomist as he is a judge of everything else, says (and if he did not say it I should do so myself) that the moral element is entirely wanting, notwithstanding a certain talent he may be possessed of as a public writer and stump orator.

"Most assuredly it is not in this way you will do honor to the municipality. Have done with all such trifles, worthy at most of occupying the attention of a village council. Apply yourselves to something worthy of deliberating on. Elevate yourselves to the position of representatives of one of the oldest and most important cities of Canada. Restore your laborers' wages, put those of your officers back to their former figure of 1878, unless you further increase them, which you should do in the true interests of the city. Take on the necessary hands to do the work, and that nothing may be neglected as things are at present, and for the purpose of collecting the revenue, together with all arrears which without such aid will remain a dead letter.

"Effect a loan, lay down a second line of pipe, consolidate the city debt. You will thereby in course of time save $100,000 yearly in interest and sinking fund. Settle immediately with the government the subscription in favor of the Q., M., O. & O. R. R., that in favor of the Lake St. John railway, the cession of the Palais harbor.

"Be not formalized at my telling you so. If I am your employé, remember that I am also like yourselves a citizen, and that, as you are now, I was in 1861 deputed by the municipal assembly for a term of three years and unanimously re-elected for a second term of like duration. Listen not to that portion of the city press which in its ignorance, error and bad faith, advises you not to allow yourselves to be lectured by me, and does so only with the view of fomenting hatred and discord in the municipal camp.

"On the contrary, gentlemen, it pertains to me who have been here for twenty years as deputy and engineer, and who knows as much and more of municipal affairs than any other man in the city, to impart such knowledge to my neighbors. Do not forget that, like you, I am an interested proprietor, and that, as such, I cannot give you bad advice or counsel things improper without being with you a victim to my own erroneous teachings."

A VALUABLE BOOK.

How many engineers and surveyors are content to operate upon the surface of mother earth without a thought as to her real shape and dimension, or the process through which our present knowledge of the subject has been reached. Without going into the more abstruse problems of geology, Prof. Merriman has given us, in his little book, the substance of a course of lectures on the figure of the earth, delivered to the civil engineer students in Lehigh University, and is properly an introduction to the science of geology as illustrating the steps through which our present knowledge has been acquired and the difficulties in the way of an extension of that knowledge. It is not addressed especially to the scientific student, whether engineer or surveyor, but it is so far popularized that there are few persons of ordinary intelligence who may not read it with profit and certainly great interest.

The day fixed by ordinance for submitting the question of water-works under the existing contract to the people of Hamilton, O., is Dec. 24, 1881.

PERSONAL.

F. de Funiak, General Manager of the Louisville & Nasville Railroad, was in the city this week.

Mr. Donald Allen has been duly installed Division Superintendent and Engineer of the Texas Central Railroad, with headquarters at Waco.

Geo. A. Morison, Mem. A. S. C. E., Chief Engineer of the Bismarck Bridge, on the line of the Northern Pacific Railway, has returned to the city to remain until next spring.

Gen. Theo. G. Ellis, Mem. A. S. C. E., Hydraulic Engineer, of Hartford, Conn., has been spending the week in this city, on business connected with an important patent lawsuit.

The Railroad Conductors' Convention at New Orleans elected R. B. Brown, of the Louisville & Nashville Railroad, President for the ensuing year, and decided to hold the next annual meeting at Milwaukee.

Messrs. Cushman & Fairleigh, Civil Engineers formerly of Illinois, in which State they were extensively engaged in railway surveying and construction, have opened an office in Chattanooga, Tenn., with very encouraging prospects—that city being one of the principal centers of the coal and iron trade in the South, and its rapid growth and progress being inevitable.

There is considerable gossip concerning the suit of the Keeley motor stockholders against Keeley, to compel him to give them information regarding the apparatus. Keeley's nephew, who is his companion in the workshop, is skeptical of his uncle's invention, and says he often heard him say there was more money put in the thing than can ever be got out. The nephew says the engine has never yet been run by vibratory power, and during the recent exhibition a sort of quicksilver was used.

The arrival in the Servia of Mr. Franklin B. Gowen will probably add interest to the suit just brought by Mr. Daniel Dougherty as counsel for Mr. James McHenry, who asks damages from Mr. Frank S. Bond, the President of the Reading road, who, in an interview in a Philadelphia paper, is alleged to have said: "Mr. Cave, Vice-President, is an idiot, and don't know what he is talking about. He is the mouthpiece of Jim McHenry, the veriest vagabond that walks London streets, and a notorious stock-jobber."

In an engineering point of view the entire line of the Texas Pacific Railroad from Fort Worth to Blanco is of the most interesting character, and even a layman could not fail to be impressed with the magnitude of the work, the genius with which all difficulties have been met and conquered and the thorough, careful manner in which every inch has been constructed. And in this place honor to whom honor is due. Major D. W. Washburn, the chief engineer of the Improvement Company, a young man, but a worthy pupil of the great engineer whose lieutenant he is, and full of capacity and genius, has had entire supervision of the construction of the line, and it is but just to say that the magnificent work that he has accomplished entitles him to a place in the highest rank of railway engineers.

A curious and interesting contest is being conducted in Columbus, Miss., by the Standard Oil Company. Three years ago the merchants at that place asked the company to vary its prices according to the market, and upon being refused, combined together and bought oil from other quarters. The Standard Company then lowered its rates, and finally put a local agent into the field to undersell the merchants at retail, but still the latter refused to surrender, and to this day have handled none of the company's goods. Finally the monopoly has put a great quantity of groceries into the town to be

sold at cost, and a small dealer who had built up a petty business in chipping dried beef for his customers had to see the great company set up an opposition grocer next door to punish him for refusing to sell its oil. The merchants of a small town can hardly be expected to hold out against warfare of this kind. It is to be hoped, however, that their struggle will not be without good results.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 489.)

CLIII.—QUEBEC.

Quebec, Canada, in lat. 46° 48′ N., long 71° 16′ W., is on the St. Lawrence River on a promontory at the mouth of the St. Charles River. The point, called Cape Diamond, is 333 ft. above the river. The upper town is an elevated table-land, and the lower town is a narrow belt along the St. Lawrence backed by a cliff, and a strip on the St. Charles about 2,000 ft. wide, of more gradual ascent.

Founded in 1608, it was incorporated as a city in 1841. Water-works were built by the city in 1853, after the plans of George R. Baldwin, C. E., taking the supply from the St. Charles River at Lorette, 9 miles from the city, 486 ft. above the St. Lawrence, and 150 ft. above the highest point in the city. A stone dam across the river, 200 ft. long, 14 ft. high and 6 ft. wide at top, diverts the water into a subsiding reservoir. The water-shed of the river at this point is about 500 square miles. About 3 miles above the dam the river widens into Lake St. Charles.

From the reservoir the water is conveyed 40,969 ft. in an 18 in. cast-iron pipe to the city. In passing under the St. Charles River near the city the pipe was imbedded in timber and concrete 5 ft. under low water. In 1872 it was found that the pipe leaked from a portion of a lead joint having blown out, and that there was a hole 1¼ in. in diameter in the spigot end of the pipe in that joint. The jet from this hole, which was under a pressure of 210 lbs. per square inch, had cut 3 in. into the wood-work of the box and nearly through a 7-in. post. The pipe was repaired by banding it with a cast-iron sleeve with lead joint. Within a year the jet had cut through the sleeve a hole 2 in. wide. The defective pipe was then cut out and replaced. Afterwards the main was carried across the river by a pipe-arch bridge of 120 ft. span, surrounded with wood.

As early as 1860 there were complaints of insufficient supply. Experiments by T. C. Keefer, C. E., showed excessive waste, the lowest average night delivery in April being 88 per cent. of the highest average day delivery. The tubercular corrosion of the main diminished the supply also.

In 1865 G. R. Baldwin, C. E., found that the main was virtually reduced by incrustations from 1.50 to 1.28 ft. diameter. There were then 3,035 taps, and the consumption as measured was 3,000,000 gallons under the existing arrangement of throttling certain sections for portions of the day, while a constant supply at the rate of consumption in the several districts when under full head of water would have required 7,200,000 gallons per day.

Distribution is by cast-iron pipe, of which 27.5 miles are in use, of from 14 to 4-in. diameter, mainly of 4-in. There are 222 fire hydrants, 112 gates and 5,016 taps.

The population in 1880 was about 50,000, and the daily consumption about 3,000,000 gallons.

The works have cost $1,300,000, the amount of the bonded debt. The gross receipts have been about $2,000,000. In 1880 the expenses of maintenance were $'0,000 and the revenue $90.000. The City Engineer, C. Baillairge, C. E., has been the manager of the water-works since 1866.

CLIV.—NASHVILLE.

Nashville, Tennessee, is in lat. 36° 10′ N., long. 86° 49′ W., on the south bank of the Cumberland River, on rocky bluffs, rising from 80 to 175 ft. above low water. The town was settled in 1779; incorporated as a town in 1806. In 1832, the population being 6,000, water-works were built by the town, after plans of Albert Stein, C. E., taking water from the river and pumping it by a direct-acting steam pump of 26-in. cylinder with 96-in. stroke, into a reservoir on the hill, of 3,000,000 gallons capacity, and a stand-pipe 100 ft. high.

In 1878 two duplex Dean pumps were erected. Distribution is by cast-iron pipe, of which 42 miles are in use of from 36-in. to 2-in. diameter.

No statistics of the number of hydrants and taps have been furnished.

The population in 1880 was 43,461, and the daily consumption 6,000,000 gallons.

The works have cost $1,500,000, and the gross receipts have been $1,215,227.20. The expenses in 1880 were $65,667.93, and the receipts $64,541.42.

There was no bonded debt until 1880, when a loan of $75,000 was created, bearing 6 per cent. interest, to extend and improve the works. Jas. Wyatt is Superintendent.

CLV.—AKRON.

Akron, Ohio, in lat. 41° N., long 82° W., is on the Little Cuyahoga River, on the highest ground between Lake Erie and the Ohio River, 495 ft. above the Lake, and 1,065 ft. above sea level. The town was settled in 1825.

Water-works were built by a private company, in 1880, after the plans of Joseph Flannery and E. J. Frost, civil engineers. The supply is taken from a bed of water-bearing gravel. A brick well, 50 ft. in diameter, the walls, from 30 to 18 in. thick, resting on a cast-iron shoe, was sunk 32 ft. by excavating from the interior and allowing the curb to settle by its own weight. The water stood 16 ft. deep in the well.

Two Worthington engines, one non-condensing, of 1,000,000 gallons capacity, the other a duplex-condensing engine of 1½ million capacity are provided, pumping through 2,500 ft. of 16-in. pipe into a reservoir on Sherbondy Hill, still in excavation and embankment, 250 by 200 ft. and 14 ft. deep, lined with 18 in. of puddle on which is laid a pavement of sandstone blocks laid in cement.

Distribution is by cast-iron pipe, from 16-in. to 3-in. diameter, 20 miles of which are in use, 6¼ miles being of less than 6-in.

There are 157 fire hydrants, 40 gates, 600 taps and 10 meters. The city pays $45 per year for each fire hydrant.

The population in 1880 was 16,512. The delivery of water to consumers began on May 19, 1881.

The capital stock of the company is $250,000, and there is a bonded debt of $200,000.

Edward J. Frost is the Secretary, Treasurer and General Manager.

CLVI.—LEADVILLE.

Leadville, Colorado, in lat 39° 15′ N., long. 106° 20′ W., is at the head of the Arkansas River, near the summit of the Rocky Mountains, 10,500 ft. above the sea. Settled in 1878, it was incorporated as a city in 1879, in which year water-works were built by a private company. The supply is taken from a stream in Big Evans Gulch, which has about 16 square miles water-shed, heading in the Mosquito Range. A dam in the gulch, a mile and a half from the city, forms a reservoir 300 by 200 ft., and 16 ft. deep. From this a line of 2,200 ft. of 12-in. and 5,364 ft. of 6-in. pipe conducts the water to the distributing tank, 185 ft. below the dam and 164 ft. above the city. It is of wood, 40 × 20 × 16 ft.

A Knowles pump is also connected with the tank by a 4-in. pipe, drawing its supply from springs in California Gulch.

Distribution is by cast-iron pipe, of which 3 miles are laid, with 52 fire hydrants, 21 gates, 250 taps and 2 meters. Lead service pipes are used.

The population in 1880 was 14,820, and the daily consumption about one million gallons.

The capital stock of the company is $300,000, and the bonded debt $65,000, bearing 8 per cent. interest. The total receipts from April, 1879, to Oct. 1, 1881, were $68,500. The expenses in 1880 were $12,402.15, and the receipts $30,722.85.

H. W. Lake is the Secretary, Treasurer and Superintendent, and J. C. Cramer the General Manager.

(TO BE CONTINUED.)

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GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Newark Water Company, of Newark, O., capital $200,000, was incorporated last week.

Geo. F. Bramhall, C. E., formerly an assistant on the Chicago water works construction, is again before the people of that city with his Aqua-Port.

Corry, Penna., is agitating the question of a public water supply and a system of sewers; the project is not, however, so far along as to have a recognized leadership in the matter. They are waiting for the "coming man" to promote it.

So many citizens of Santa Barbara, Cal., discontinued the use of gas and employed kerosene that the gas company announces that if the people will continue and resume their patronage it will reduce the price from $6 to $3 per 1,000 feet.

Orange, N. J., is discussing the question of erecting water-works. It is thought that they can be built for $80,000 or less, and the town counsel has given his opinion that the law of 1876 will authorize issuing the necessary bonds.

Hornellsville, N. Y., has entered into arrangements with the Warren Pipe Works, of Philipsburg, N. J., to supply the village with water through 100 double hydrants, at a cost not to exceed $30 per hydrant; also, free water to all the village buildings, schools, etc., and one drinking fountain for man and beast in each ward. The reservoir will cover an area of 30 acres, and be capable of holding 60,000,000 gallons.

The Meadville Water-works, of Meadville, Pa., have been running their machinery since their formation by water-power; but, owing to scarcity of water last season for about two months, they have decided to put in steam. The engines and boilers are made by the Phœnix Iron-works, of Meadville, and are of 150 horse-power. The cost of the change will be $6,000.

A special meeting of the Newport, Ky., Water-works Board was held on the 3d to receive bids for additional pumping machinery. The two propositions were for an engine capable of pumping 3,000,000 gallons of water per day, or for two engines with a capacity of 2,000,000 gallons each. Bids were presented only from Cope, Maxwell & Co., of Hamilton, Ohio, and the Holly Manufacturing Company, of Lockport, N. Y. The former firm made a proposition to furnish two engines of the capacity mentioned for $74,500, or one engine with the power to furnish three million gallons per diem for $55,000. The Holly Company proposed to furnish two two-million gallon pump engines for $51,500, or one three-million gallon pump engine for $48,000. The matter was laid over for due consideration.

STREETS, DRAINAGE, ETC.

The city of Houston, Texas, has decided to pave its streets with wood, and contracts are called for.

Northampton, Mass., wants sewers, and Mr. Waring is on the lookout for their construction.

The sewerage problem is receiving consideration at the hands of Canton, Ohio, tax-payers just now. The prevalence of malarial fevers in and about Canton calls for some action toward establishing an efficient system of sewerage. Councilman Archinal has submitted a resolution to the city council to appropriate $50,000 to be used in the construction of a sewerage system similar to that now in use in Memphis, Tenn. This was recommended by Mr. George E. Waring, Jr., of Newport, R. I., who made a thorough inspection of the geological surroundings of Canton last spring. No action has yet been taken on the resolution, and it is probable that the matter will be submitted to a vote of the people. Some object to it on account of the expense, but the ever increasing growth of Canton will soon compel some action in the matter.

BRIDGES.

ST. LOUIS, Dec 8.—While a freight train eastward bound on the Western Division of the Wabash Railroad was crossing the bridge over the Missouri River, at St. Charles, about six o'clock this evening, the eastern span of the bridge gave way, and the entire train, composed

of thirty-two cars, thirteen of which were laden with live stock, was precipitated into the river about eighty feet below. The engineer is missing, but everybody else on the train escaped.

RAILROADS.

An action has been instituted in the Supreme Court of the State of New York, to be tried in Monroe County, by Isaac S. Waterman, of Philadelphia, and Henry A. Taylor, of Rochester, contractors and builders of the Rochester and State Line Railroad, against William H. Vanderbilt, its former manager, for the recovery of $1,000,000 damages alleged to have been sustained by reason of a breach of contract on the part of the defendant.

At a meeting of the stockholders of the New York and New England Railroad, Dec. 6, the Jay Gould party were chosen directors by a vote of 94,000 out of 96,000. The following are the new directors: Jesse Metcalf, Jay Gould, Sydney Dillon, Cyrus W. Field, W. T. Hart, James H. Wilson, James H. French, F. C. Fitz, Geo. T. Roberts, H. J. Jewett, L. B. Cannon, Fred. J. Kingsbury, R. Suydam Grant and Henry L. Higginson.

The New York *Sun* says: The Canadian Pacific Railway Company is making a great effort to sell its 5 per cent. bonds in this market. As the only security it offers at present for the interest as well as for the principal consists of wild land in the remote north of the continent, investors will hardly care to pay par, which is the price asked, for a security of such doubtful value. Their experience with the old Northern Pacific Railroad bonds is not yet forgotten.

Mayor Grace, in transmitting to the aldermen a communication from Messrs. Butler, Stillman & Hubbard, of this city, relative to the protection of the rights of the city in the proceedings now pending in the matter of the Broadway Underground Connecting Railway Company, said: "I have grave doubts as to whether the construction of an underground road under Broadway would not be a serious detriment to the interests of the city, but in any event I am satisfied that no such structure should be built, except upon condition that the manner of its construction meet with the approval of the Mayor, Comptroller and Commissioner of Public Works. To appropriate the core of Broadway for railway purposes would be to deprive the city of a valuable property needed for public purposes, and would necessarily interfere with the entire pipe and sewer system of the street. I should be pleased to concur in any legislation to protect the interests of the city which your honorable board may be pleased to pass."

The Pennsylvania Railroad Company opened its new depot at Merrick and Filbert streets, Philadelphia, on the 5th, for general traffic, and all trains are now run over the elevated road into the heart of the city.

The Gulf, Colorado & Santa Fe Railway, opened its whole length on the 2d inst., was organized in 1873 by Galveston men, and its mother was necessity. The mercantile interests saw that a road owned by Galveston was a safety-valve. After many meetings and canvassing for subscriptions the road began surveying lines and then locating. Aug. 1, 1880, the road was open for business between Galveston and Brenham, 136 miles. Nov. 1, 1880, the road was opened to Milano Junction, 174 miles, and connecting with the International & Great Northern Railway; on Dec. 1, 1880, to Cameron, 186 miles, and on March 1, 1881, to Belton, 220 miles. Thus it will be seen that between Aug. 1, 1880, and March 1, 1881, 100 miles were built, the difficulties of earlier stages of building to Brenham having been overcome. The distance from Galveston to Fort Worth is 345 miles. Including the eight miles of main line from Temple to Belton, the road from Temple to Fort Worth being the branch, the Santa Fe operates today 353 miles of road, penetrating 12 counties and passing through ten old-established towns, viz.: Richmond, Bellville, Brenham, Caldwell, Cameron, Belton, Clifton, Meridian, Cleburne and Fort Worth. Besides these the road has eighteen towns of its own and a few infants coming on. The road penetrates the ridge between the Brazos and Colorado rivers, a section second to none in the State, and now feeling the effect of railway facilities in the way of rapid settlement. The road is hailed with delight by Fort Worth, as it establishes a competitive line to Galveston and Eastern markets.—*Galveston News.*

NEW PROJECTS.

The Toledo & Detroit Air-line Railway Company; capital, $1,000,000.

The Indianapolis Construction Company, of Washington, O., and Indianapolis, Ind.; capital, $100,000.

A surveying party left New Orleans on the 3d to go over and locate the route of the proposed New Orleans, Red River & Texas Railroad, the objective point of which is Palestine.

The Austin & Northwestern Narrow Gauge Railroad surveying corps were eight miles above Liberty Hill, Tex., on the 1st, and were moving in the direction of Burnet.

Arcticles of incorporation of the Chicago & Peoria Railroad Company have been filed. The capital stock is $3,000,000 and the incorporators and Board of Directors are T. D. Catlin, E. C. Lewis, H. L. Glover, H. S. Hawley and A. L. Griffin.

The Fond du Lac, Wis., county board have voted to erect a new court-house costing $65,000—$35,000 is to be provided for in the assessment for the present year, $25,000 in the assessment of 1882, and $15,000 in the assessment of 1883.

The printed specifications of the new Austin Tex., capitol building, with form of contract and description of capitol lands, were completed in pamphlet form on the 1st. The contract is an iron-clad arrangement, which at least one intending bidder declares he would never sign.

Col. Victor K. Miles, chief of the locating party working on the Trinity & Sabine Railroad, was at Palestine, Tex., on the 1st. Two lines are located, one running from Red Branch, on the International, to Caney Creek, the other from Trinity Station to the same point, which is the junction of lines run thus far.

The plans for the building of the Methodist Episcopal Hospital have been adopted. They were prepared by Mr. John Mumford, who will receive the prize of $400 for them. The hospital is to cost between $400,000 and $500,000. Mr. Geo. I. Seney has given 240,000 of that amount. The hospital will be built on the block bounded by Seventh and Eighth avenues and Sixth and Seventh streets, South Brooklyn.

The Central Tunnel Railway Company of New York filed articles of association on the 7th. The capital is $5,000,000. The road is to commence near the City Hall Park, and terminate near the Grand Central depot, and will be five miles long, connecting with the Fourth Avenue Improvement. It will run under Chambers, Reade, Elm, Spring and Great Jones streets, Lafayette place, Astor place, Eighth and Ninth streets and Fourth avenue.

Redfield (Iowa) people are very enthusiastic over the prospect of the Minneapolis & St. Louis Railway coming to our town. As soon as they heard the surveying party was coming this way, a meeting of the citizens was held. A committee was appointed to go to Perry and consult with the engineers. The survey is now completed through the town, establishing their crossing over the Des Moines Northwestern track about twenty or thirty rods east of the depot.

A new railroad company has been formed under the name of the Arizona & Nevada Railroad and Navigation Company. Its object is the construction of a line between Callville, Nev., and Yuma, with extensions by rail or water, as may hereafter be determined, to Port Asabel and Libertad, on the Gulf of California. The capital stock is $20,000,000. The San Francisco directors are P. Peckham, John N. Risdon, John Lloyd, Robert N. Risdon and J. W. Smith. The Arizona directors, Paul Brion, John J. Gosper and Frank Staples; and W. H. Stymus, of New York. The road will pass through a line of rich mining districts.

The capital stock of the Bennington Cut-off, Middletown Springs, and Lake Champlain & Lake Ontario railroad companies has been taken, and the stockholders of the three companies will meet on Jan. 17 to organize and prepare for the work of construction. These railways together will form a system between Boston, Chicago, and Canada by way of the Grand Trunk and other Canada railways; also, between Boston and Montreal by way of the Hudson Canal Company's railroad and the waters of Lake Champlain and railway connections; also, between Boston and Rutland over the Bennington & Rutland Railway west and north of Hoosac Tunnel, and the Massachusetts Central Railroad on the east of the tunnel, and extending from there to Boston. At Boston connections are to be formed with a line of ocean steamers between that city and Liverpool and other places in Europe.

The Leavenworth, Olathe & Southern Kansas Railroad company was organized on the 5th. The corporators are E. P. Wilson, Joseph Whittaker, H. D. Rush, S. F. Neely, Matt Ryan, J. W. Cranucer, M. H. Insley, T. A. Hurd, of Leavenworth; Henry Hopkins, of Lansing; J. Harris, of Olathe, and Tom J. Anderson, of Topeka. This line will tap the Missouri, Fort Scott & Gulf and the Santa Fe & Olathe. It will also make a direct line from Leavenworth to Memphis, Tenn., as soon as the Gulf road is finished to that point. The road is to run from Fort Leavenworth through Wyandotte, Johnson, Miami, Franklin, Anderson, Coffee, Woodson, Greenwood, Butler and Cowley counties. When completed, with branches in Wyandotte and Johnson counties to the State line at Kansas City, the road proposes building a branch from Atchison to Leavenworth.

The application for a new railroad charter, to be made at the next session of the Connecticut Legislature, which was referred to yesterday, undoubtedly appertains to a scheme which has been on the tapis for some time, and for which surveys are being actively made. The parties interested in the new scheme are keeping their plans to themselves for the present, so far as they are able, but we understand that the public will be soon let into their secret if the surveys prove as favorable as expected. From the few items of information allowed to transpire, we learn that it is proposed to construct and equip a line of railroad between Boston and New York far ahead of any now running between these cities, and even superior to any road in the country. It is claimed that the distance, via the new line, will be only 180 miles, and that, as the road is to have no grade-crossings whatever, is to be almost straight, and capable of maintaining a speed of 60 miles per hour, it will only require three hours to run between Boston and New York. Fifty millions is said to be about the estimated cost of the new enterprise.—*Boston Journal*, Dec. 8.

The proceedings of the Yonkers Rapid Transit Company for the right of way into the city of Yonkers have been completed, and the commissioners appointed last September have made their reports as to the right of way which the company seeks to acquire. The new line is to leave the New York City & Northern Railroad near the southern part of the estate of Augustus Van Cortlandt, and continue in a northwest direction, always keeping easterly Broadway. The company proposes to begin building immediately, and the work will be pushed rapidly to completion. After leaving Getty Square the road will be elevated on a structure similar to the elevated railroads in this city for about 1,200 feet, and thence it will be a surface road. The engineering of the road, in respect to its grades, curves, ironwork and masonry, has all been planned with a view to rapid transit, and the line as at present laid out, from Getty Square to Kingsbridge, by the New York City and Northern Railroad, is about three-quarters of a mile shorter than by the Hudson River Railroad route. The commission have awarded about $100,000 as a just compensation for the property taken and damage done within the limits of the city of Yonkers. That portion of the line which is within the limits of the city of New York has been condemned for about $20,000.

The Jacksonville *Union* announces that the early building of the Jacksonville, Tampa and Key West Railroad is assured, and that Jay Gould, Samuel J. Tilden, Governor Cornell, Winslow, Lanier & Co., Milton Weston, of the Chicago Belt Line Railroad, and other capitalists have taken the matter in hand and will push the road to completion. The road will run on the west side of the river to Palatka, and thence direct to Tampa. A steam ferry is to be established from Palatka to a point on the opposite side of the river, and a road run from there to Titusville, a distance of over one hundred miles. The contract for grading this branch of the road has been let to a firm in Ohio, who have arranged with parties in Georgia to furnish 1,000 men to do the work and are to have the grading completed by the first of April. The contract for building the road from Jacksonville to Tampa will be let, when the work of grading will be at once begun, and it is the intention of the company to have the road completed in six or eight months. The roads are to be of the standard Northern gauge, and at an early date a branch road will be run from the main line to Key West via Punta Rassa, and a line of first-class steamers put between Key West and Havana. The headquarters of the road will be established at Jacksonville, where all of the machine shops, etc., are to be erected, and negotiations are now making for suitable ground for a terminus.

CONTRACTING, MISCELLANEOUS, ETC.

Hallanin & Mober were the lowest bidders on the construction of the shaft and tunnel at the new waterworks at Hyde Park, Ill., and the contract was awarded to them at $14.75 per foot.

The Hamilton, O., County Commissioners have accepted the Trenton bridge work done by McKeon & Flenner under their contract. The whole cost of the work done by the contractors amounts to $17,068.22.

A contract has been signed between the Baltimore & Ohio and Buffalo, Pittsburgh & Western railroad companies for the interchange of business, the latter road to build an extension 136 miles from Newcastle, Pa., to Chicago Junction, where it connects with the Baltimore & Ohio, thus giving the latter an outlet to Lake Erie.

The closing of Tone's bayou, which was about completed according to government specifications, broke on the 1st. The amount of damage is not known, it being some distance below Shreveport, but the river fell in a few hours three feet. There has been about $35,000 expended on it.

A company for the improvement of Green's Pond, at West End, Long Branch, into a lake has been formed. Surveys have been finished and contracts for excavation and other work will soon be let. The Brokaw Brothers, Astor Place and Fourth Avenue, this city, are at the head of the enterprise. Frank H. Earle, C. E., Jersey City, is the engineer. The tract to be improved covers about seventy acres, and probably $50,000 will be expended. There is to be a 200 feet bridge, to be built over the lake. Contract not yet let. Matthias Wooley, Long Branch, is the man to address.

The Grand Rapids and Indiana Railroad Company let the contract for building the northern extension of its road from the present northern terminus to the Straits of Mackinaw. The successful bidders were L. A. Rose, of Bronson, and McDonald Bros., of Grand Rapids. The terms of the contract are that the road is to be completed by Jan. 13 next, and it is expected that passenger trains will be running to the Straits by July 15.

Construction on the Texas-Mexican railroad has begun to the extent that dirt has been turned on the bay front at Caronkaway in the location of a bridge site. Mr. Gardner, General Manager of the road, is expected to arrive in Galveston any time between the 1st and 10th of this month, and general construction will commence immediately thereafter. The work will be started first at Galveston, and afterward will probably be begun at San Diego and Victoria. The track will be laid with new steel rails the whole way through. The bridge across West Bay will be about 12,000 feet in length, and will be pressed to completion as fast as possible to make it a first-class piece of work. Chief Engineer Fuller is in San Antonio looking after the survey of the line from that place to Beeville. He will return here about the last of this week. General Palmer is now in Europe in the interest of the company, and is forwarding supplies with all possible dispatch. Material of all kinds is arriving both at Galveston and Corpus Christi, and is being pushed to the front with all the speed that men and steam can accomplish. The steamer Nettie will leave here to-day for Corpus Christi, laden with three locomotives and other material for use on construction in Mexico. Track is laid on the west side of the Rio Grande a distance of about ten miles from Laredo, and will, it is thought, reach Lampasas by March 1.

ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 17, 1881.

THE regular edition of *St. Nicholas* in England is now eight thousand copies. Ten thousand copies of the Christmas number are being sold there.

THE attention of contractors is called to the large contract on the Boston Improved Sewerage—advertised elsewhere in this journal this week—to be let on the 24th inst.

THE new international railroad line, which is to give more direct communication between France and Spain, will necessitate another large tunnel. The Pyrenees will be cut, much to the disgust of some of the military folk of both countries. The expense of the tunnel will be paid by the Spanish and French governments. It will be six thousand, six hundred meters in length.

A QUESTION FOR RAILROAD EXPERTS: WHAT IS "GRADING?"—A case of some importance in a neighboring State will be brought before the courts on a question as to what constitutes the "grading" of a railroad; one side claiming that it embraces, in addition to cuts and fills, the construction of bridges and culverts, or in other words the preparation of the entire road-bed ready for the cross-ties; the other claiming that the grading includes only the cuts and fills.

As there is something to be said on both sides of this question, we should be pleased to furnish space for such as may be disposed to state their views or discuss the question, pro and con.

AT a meeting of the Civil Engineers' Club of Cleveland, held on the evening of Dec. 13, an interesting paper on the "Crystallization of Iron' was read by Mr. N. P. Bowler. It called forth quite an animated discussion, and a relation of the experience of members of the club on the subject. It is on the programme for the next meeting, when more will be said on the question, "What Causes Crystallization." The proceedings of this organization are published monthly in a very neat pamphlet, in connection with those of the clubs of Boston, Chicago and St. Louis.

G. B., of Lowell, Mass., writes us as follows:

"Will you club ENGINEERING NEWS with other papers this year the same as last? If so, let me know what the price of ENGINEERING NEWS and the *Century Magazine* will be. I see that club agents offer them at quite a reduction."

In answer thereto we repeat what we have heretofore published, that we will club with any newspaper, magazine or periodical in the country, and will allow *all the commission that we receive*, less five cents for transacting the business. The Harper's and the Century magazines are $4.00. We will send them to *any address*, and in any number sent us *by subscribers* to our journal at $3.25; if any news agent can do better, he has the "inside track," and we yield it to him. Our subscribers can always rely on getting more for their money by dealing *direct* with us than through any news agent; these gentlemen are useful in their way, but their labor in the field of class-journal circulation is so small as to be hardly appreciable.

THE January *Century*, a large edition of which is on the press, will be delayed this month until the 23d. One of its novel features is to be a frontispiece printed in tint—a portrait of ex-President Thiers, accompanying an article by the Hon. Elihu B. Washburne, our former Minister to France. A full-page portrait of Queen Margaret of Italy is given in connection with an article on the making of Burano lace, for which the Princess Louise of England has made a sketch. The number also has another portrait of President Garfield (from an artotype by Edward Bierstadt, N. Y.), which will accompany an anecdotal paper by Colonel A. F. Rockwell, entitled "From Mentor to Elberon." The immediate friends of the late President regard this portrait as giving a somewhat different phase of the late President's character from that presented by the engraving by Cole in the December *Century*, and as revealing his affectionate qualities, while the latter was especially strong on the intellectual side of his nature. The artotype is also interesting as being the portrait Mrs. Garfield selected to send to Queen Victoria. The sale of the November and December *Century* still continues. A new edition of nine thousand of the latter number has just been issued.

THE giant forces which scientific discovery is putting in the hands of engineering bid fair to develop a particular form of the profession. Works, the very immensity of which prevented the thought of their being entertained in former times, are now, as it were, the very objects which speculative syndicates and courageous companies are looking after. Oceans are joined together, mountains leveled and the face of nature considerably "transmogrified." A special class of engineers are being educated for these works, but although some of the world-famous projects are nearly finished, others are cropping up at such a rate that there is no likelihood of an immediate dearth of employment.

The Isthmus of Corinth is now to be cut, for a company has just been definitively constituted, and the report by General Turr has been drawn up. The territory of the isthmus is comprised between the Geranian mountains, which vary in height from 1,800 to 3,000 feet. M. Gerster, who had been already engaged in the Darien survey for the interoceanic canal, was sent with a number of engineers to make the necessary surveys. Three lines have been surveyed and leveled. The first coincides with the line laid out by the engineers employed by the Emperor Nero in the second half of the first century of our era. It is 6,342 meters in length, and is 78 meters above the sea level. There are two variations of this line, one of which starts from Kechrioes on the Ægean Gulf and follows the valley of the river Levka, falling into the Southern Sea near the modern city of Corinth. This line is eleven kilometers.

The surveys show that the line of the ancients gave 9,430,000 cubic meters, while the latter gives 12,424,000 cubic meters. The line adopted by Nero is straight, while the others have numerous curves of a minimum radius of 2,000 meters. In addition to this advantage possessed by the former line, there are some others. Soft sandstone and calcareous gravel form the principal elements of the soil, and the slopes are so that the canal would be protected from the drainage of the valley waters, etc. The advantages of having a straight line for navigation are simply of an imperative order.

The depth of water and width at top would be the same as for the Suez Canal—eight meters and twenty-two meters respectively.

The distance gained by the canal would be one hundred and eighty-five miles from the Adriatic to the Piræus, and ninety-five miles for vessels from the Mediterranean. Even in Periander's time, 625 B. C., there was "some talk" of cutting the isthmus. There is nothing "new under the sun" it would almost appear after all.

SEWERAGE OF AMERICAN CITIES AND TOWNS.

In the *Journal d'Hygiène* for November we find a report in brief of the system of sewering pursued in the city of Memphis, Tenn., by George E. Waring, Jr., with an engraved plan of the city, showing the lines of main and branch sewers, as also plans of the accessories in use there, and we are led to notice this paper in connection with reviews of the sewerage works of American cities, as the claims made in support of the introduction of the system in Paris, rest mainly upon its successful working in Memphis.

After explaining the principle of this working, which consists in confining the sewers proper of a city to the discharge solely of the house waste (for which a pipe of very small diameter will suffice), he endeavors to show that instead of increasing the water supply, or increasing the volume of water in the mains, by introducing the rain water from roofs, yards and streets, with a view to the better sweeping of the fecal and other house wastes to the outlet, it is better, in a sanitary point of view, to so concentrate the discharge from the houses as to insure the regular periodical flushing of the contents of the small sewer by means of the ordinary water supply husbanded by means of flushing tanks located at the head of the branch sewers, and declares that the system is as applicable to the City of Paris of over two millions of people, as to the City of Memphis of less than forty thousand, and we cannot deny that there is much of plausibility in the arguments brought forward in support of this view. There is no novelty in them, however, and in the proper place we would be ready to accord them their full weight, but not to the extent perhaps of admitting that, "if Paris were in possession of a net work of sewers, constructed on the model of that of Memphis, all its filth could be carried away through the application of the Fields flushing tank, with a volume of water ten times less than what they consider to-day is indispensable." It is at once evident that unless the sewage can be deodorized, the Seine, the natural outlet for all this sewage, would become little better than an elongated cesspool, and would call for extra works of some sort for its purification or removal. And it is precisely here that our objection to the system proposed by Mr. Waring comes in. He admits the necessity, in the case of Paris, for treating this sewage, so far as to render it innocuous primarily, and of value to the agriculturist secondarily, as is done now at Gennevilliers. To utilize or to render innocuous the sewage of a couple of millions of inhabitants, which it is admitted, under this system, will become necessary, will be found to be a problem of great intricacy, if, indeed, its successful solution be possible. At all events, in this country of wide areas, there can be no market for the manufacture of feeble manure from sewage, in competition with the rich phosphates and guano, the supply of which equals all the wants of the agriculturist.

In the older countries of Europe, where such a thing as virgin soil cannot be found within any reasonable distance from the large cities, and where the system of police is, in most cases, as perfect as can be desired, or at all events, where the action of the executive in state or municipal affairs is not hampered by the sentiments of the superior claims of the individual voter to consideration, it would be possible to carry out this system as proposed for Paris, to a degree of success entirely beyond anything we could hope for in this country, and we are entirely willing that the city of Paris should lead the way and show how far it is possible to realize such an image as the "beautiful Seine cleansed of its daily pollution and emerging

from Paris with the natural limpidity restored, which it possessed before entering it."

The proposed system, if applied in Paris, will only effect by water carriage what is now effected by mechanical means.

The authorities have long resisted the introduction of the English system of water carriage, and but small advance has been made in that direction. The water-closets discharge into cess-pools within the premises, emptied at intervals, greater or less, by machinery and carried out of the city in *tonneaux*. All surface or other water is discharged into the main sewers; there are no pipe sewers in Paris. The contents of these cess-pools must, therefore, be richer in manurial ingredients than if the water supply were increased to the extent of sweeping the house sewage to the outlet, as at Memphis. Then we might reasonably expect that the value of the present sewage would be greater than by the proposed improvement.

In Paris the business of removal and preparation of the manure is let to a contractor, and he would appear to make a gain out of the transaction; that is, the public funds are benefited by it: but not so the tax-payers. They pay a considerable sum for the emptying of their cess-pools, 8 francs a cubic meter, 15 francs for a *fosse mobile*, and Mr. Krep calculated that the resulting *poudrette* sells for 47½ francs, which costs the city 146 francs!

EAST RIVER BRIDGE.

Ex-Controller Steinmetz lectured on Sunday, 11th inst., before the "Spread the Light Club," (whatever that may be), on municipal affairs, but, in reality, it would appear, that the occasion was merely made use of to attack the integrity of his former associates in the trusteeship of the important work of the East River bridge. He indulges in some plain speaking, such as "perhaps an explanation from Mr. Kingsley and his special associates in the board of trustees will be exacted by an outraged people ere the next legislature is permitted to vote away another million and a half of their money," and that, prior to obtaining any further aid, "the board of trustees should submit a complete and final plan, from which no changes are to be made, to a committee of *competent* engineers and contractors, and all disbursements hereafter to be made by the controllers of the two cities, upon approved vouchers of the commissioners of public works respectively," and speaks of "guesses," and "schemes hatched in secret conclaves," and "doctored contracts," and finally, after referring to the corrupt city government, and suggesting plans for the future, winds up with, "how long, oh, Lord! how long?"

As the adjourned meeting of the board of trustees was to take place on the 12th inst., and highly interesting proceedings were anticipated, the ex-controller and trustee perhaps thought that his thunder would produce some stir or sensation among the culprits—possibly be referred to a committee with power. But if he had any such hopes, the closing paragraph of the report of the proceedings of the club, of which, whether a member or not, he saw fit to make the vehicle of his lucubrations, would, or should, have shown him the futility of any such hopes. In the discussion which followed his lecture, it seems that the views of the association were to the effect "that all salaries of office-holders should be reduced; that all street railroads, ferries, gas companies and city property should be owned by the citizens at large, and that houses should be rented to the people directly by the municipality!"

The meeting of the trustees which took place on the 12th had been looked forward to with much interest by all interested in this most costly improvement, in hopes that the schism which has evidently existed for some time between the trustees of the respective cities would be healed.

It was known that the report of the committee of 1878, which has been referred to as giving authority for alterations in the plan, gave no such authority, and was made some twelve months before the contract with the Edgemoor Company was executed, and Mr. Roosevelt, in quoting from the Committee Report of 1878, says: "That the bridge is capable of supporting 1,100 tons of dead weight;" and, as he understood the term dead weight, "it meant the weight of the bridge itself," the term live load being applied to a rolling load, and adds: "Now, there has been added to the weight of the bridge itself, according to the Engineer's report, 1,200 tons more, and it would seem to the mind of one who is not an engineer that we had put on all that the bridge can bear, and there seems to be some reason to suppose that the whole thing may fall down."*

"The factor of safety, according to the committee's report, was to be six; according to the engineer's report it has been reduced to three. Now, who has made this change, and when was it made?" Mr. R. went on to say "that *somebody* had adapted the bridge to the use of palace cars without the authority of the board—without even the knowledge of the board;" and further, "the engineer implies that some one forced this change against the judgment and opinions and wishes of the chief engineer. Is this so or not? And if the steel is safer than the iron, as we are told, the increase of safety has been acquired against the engineer's judgment."

Certain of the trustees showed a commendable desire for information beyond the written record, and the public just now are very much exercised as to the truth or falsehood of various rumors as to the safety of the bridge, etc.; but nothing was done to relieve this anxiety or to come to any definite understanding. Of course, no notice whatever was taken of ex-controller and ex-trustee Steinmetz's complimentary lecture.

There was a warm discussion, and much was said which had better have been left unsaid. A vote of censure against some unknown individual or individuals was moved, having no reference to the ex-controller and was tabled, and a resolution was passed asking certain information of the engineer, and also a committee appointed to report upon the contract with the Edgemoor Iron Company, and whether the bridge trustees have grounds for an action for damages against the said company, after which the board adjourned to meet on the second Monday in January next, until which time the public must wait with what patience they may.

There is a circumstance which comes to light in these discussions of the board, which cannot but impress itself upon all who are interested in the subject matter, and that is, that in a work of such magnitude, and where, from its nature, there are so many points requiring technical explanation, there should not have been an accredited officer, a confidential assistant of the chief engineer, who, in the lengthened absence of the latter, should have been present with the Board at all times when any professional question was under discussion, not to give his advice, necessarily, but for purposes of explanation of technicalities. Had such measures been taken, the present misunderstanding, for it is nothing more, could not have arisen, and this unseemly squabble would have been prevented.

There is another point, which a careful study of the operations of this board of trustees reveals in our opinion, and we give it for the benefit of such timid souls as know nothing of the *modus operandi* of great achievements, yet are prone to the belief that what they cannot see is equally obscure to others, or if known, is concealed from unworthy motives. It is this: There is some one individual connected with this work, possibly a trustee himself, who, with a far sightedness which could not have been understood, had it been revealed, has persistently labored, from the inception of the work to the present moment, in the effort and in the determination, that this structure, instead of being a mere convenience between the two cities, should, by its capacity to meet all demands upon it, become a factor, and no mean one, in shaping the destiny of a section of country, which without it, had been little better than a barren waste. The cost to taxpayers was a secondary consideration with him, satisfied in his own mind that the hereafter would fully justify the outlay, and from present appearances there need be no fear of a failure of his scheme from any cause.

*To dissipate such fears as are referred to by the trustee, we would append the following, with the understanding that it claims no greater degree of accuracy than can be derived from a perusal of the printed reports of the Bridge Trustees which have appeared from time to time, and the legitimate deductions therefrom. The calculations refer exclusively to the river span, or the portion of the bridge between the towers.

	Tons.
Weight of river span	5,976
Of this there is supported by stays	1,439
Supported by cables	4,537
To this is added by late estimate of Chief Engineer	500
Making supported by cables	5,037
The load on one cable would be ¼, or	1,259

The strain on the cable by this weight will be the weight multiplied by co-efficient of tension = 1.64.

Then strain on one cable, by weight of bridge, 1,259 × 1.64 = 2,064 tons.

The maximum traffic of the bridge has been estimated as 1,311 tons on river span, ¼ = 328 tons.

The strain caused by this on a cable is 328 × 1.64 = 538 tons.

Then 538 + 2,064 = 2,602 tons is the strain on a cable, caused by the weight of bridge, loaded with the maximum estimated traffic the *breaking* strain of a cable being estimated as 12,300 tons. This gives a factor of safety (so-called) of 4.7. But the method of comparison of strains with the breaking strain is very unsatisfactory, as leaving a doubt as to how far the strain may be carried with safety within the breaking strain; the increments of approach to this point cannot be estimated with safety; but it is eminently proper to regard that point in the loading as a safe one for the estimate of strains, within which, the material will, on being relieved of the strain, resume its original length within an inappreciable fraction; or, in other words, up to this point it is not strained or crippled. This point is what is known as the "limit of elasticity," below which the strains work no sensible injury to the material; and the term factor of safety, as applied to the margin of strength between the strains imposed and what would absolutely break the material, is of no consequence whatever.

From extended tests made by the engineers, the limit of elasticity in one of these cables is reached when it is strained to the extent of 8,118 tons, and the factor of safety derived from this estimate is 3.12; but this margin of strength differs from the factor of safety referred to the breaking weight, viz., 4.6, in that the cable may be loaded up to this point, without any injury whatever being apprehended. For instance, suppose the estimate of the live load for this span, viz., 1,311 tons, should prove too small, and the traffic should increase one-half, or a total of 1,966 tons. The proportion for one cable would be 492 tons, which, multiplied by 1.64 = 806 tons, which, added to 2,064, gives 2,770 tons as the strain on one cable, or a factor of safety referred to the elastic limit, of 2.92, or nearly 3.

If the traffic should increase to *double* the estimated weight (which is scarcely to be anticipated), the strain caused by it on a cable would be 1,075 tons, which, added to the strain caused by the weight of bridge as before, viz., 2,064, would be a strain of 3,139 tons on a cable, which can be strained with safety up to 8,118 tons, or a factor of safety by this comparison of 2.58; and, in fact, by pursuing this method of calculation, it will appear that *ten times* the estimated weight of traffic *could* be passed over the bridge and supposing no aid from the overflow stays whatever, yet the resultant strains on all the cables would be 2,700 tons within the limit at which the cables could be strained without any sensible injury.

We are well aware of the statements of scientists that there is no load, however small, that in time will not destroy the material subjected to it. Possibly this may be so, but so long as these savans are unable to compute the necessary time, or life of material under these circumstances, we are at liberty, in this practical age, to content ourselves with providing for a half-dozen generations or so, leaving remoter posterity somewhat indebted to us for the lesson which our blunders may have taught them.

CITY ENGINEERING IN PHILADELPHIA.

In a previous volume of this journal we described at some length the engineering department of Providence, R. I., and characterized it as the most complete organization of its kind in this country. It is the embodiment of simplicity—one department only, with one responsible individual as its head—a City Engineer appointed by the City Council, and by the city held responsible for the proper discharge of all the important duties resulting from the designing and execution of the public works under his charge. In this case it is expected

that the City Engineer is a well-qualified civil engineer, who knows more about sewer, bridge, water-works and street construction than the average ward politician; that he knows how to subdivide his duties and properly select his assistants for the several divisions over which his supervision extends, and that a man who can well and economically "run" the public works of even a moderately sized city is worth a fair salary, such as will warrant the imposition of so many responsibilities upon him that he will have no time to spare for political engineering, his works being the best recommendation that his employers can give their constituents.

As the antipodes of the simple, sensible, efficient and economical New England organization we are bound to record the complex, wasteful, bungling and inefficient system now in use in the second city of the Union, Philadelphia, and if we unwittingly are incorrect in any of our statements, or have drawn false conclusions, we stand ready to be corrected and will be thankful for the facts in the matter.

Philadelphia is governed by a mayor and two councils—the Common and Select. The Select Council is composed of thirty-one members, each one representing a ward of the city; the Common Council is composed of nearly one hundred members, elected *pro rata*, one to every 9,000 of the population. The public works of the city are managed by departments; they are Water, Surveys, Highways, Gas, Markets and City Property; there is also a Board of Health, a Board of Surveyors and a Board of Harbor Commissioners. The "Chief Engineer and Surveyor" of the city of Philadelphia, elected by joint councils for a term of five years, is the head of the Department of Surveys and President of the Board of Surveyors. His duties are the registration of property, the designing of bridges and sewers, the regulation of street lines and grades, and of harbor lines. Having prepared the design and specifications of public work, these are submitted to the "Board of Surveyors," consisting of the Chief Engineer and Surveyor and 13 District Surveyors, who meet on the first and third Monday of each month at the Chief Engineer's office, for the transaction of such business as may come before them. These surveyors are elected every five years *by the people* of their respective districts, and the nominees are seldom changed. Each one has a practical monopoly of the surveying business of his district, and is placed under bonds for the proper staking out of all private and public property, the highways, bridges, sewers and wharf lines. For the surveys and grades of public works, they are paid by the contractors; for those of private property by the owners thereof. After approval by this board, the contract is advertised and awarded by the Department of Highways, which is presided over by a "Chief Commissioner," who has no discretion in the matter of letting, but must award to the lowest bidder who is able to furnish security in one-half the estimated value of the work. The contract awarded in cases of large works of sewerage or bridges, the Department of Surveys notifies the contractor to begin work; the contractor then calls in the District Surveyor to give lines; during progress of construction of large works it is inspected by the engineers from the Department of Surveys, upon whose certificate estimates for payment are given; but the final estimate is made by the District Surveyor; the completed work is formally accepted by the Chief Engineer, the warrant is drawn by the Commissioner of Highways and ordered to be paid by the Mayor. All payments for highways, bridges and sewers are made by the Department of Highways. Sureties are held for three years. The building of small sewers is entirely under the superintendence of the Department of Highways, which also cleans and repairs all sewers and controls the street improvements, such as paving, curbing, etc., independent of any engineering department.

In this account of the clumsy shifting of responsibility, so that in case of failure "nobody is to blame," we are not certain that we have yet fully mastered the details; if any person of an investigating turn of mind will wrestle with the question of the comparative efficiency, economy and simplicity of Quaker engineering and that of other American cities, we will be pleased to record the results.

Here is the Engineering Corps, (Water and Gas Departments and District Surveyors excluded), of an American city of nearly one million of inhabitants: Chief Engineer, salary $3,600; Principal Assistant, in charge of designs, $1,800; Assistant Engineer, in charge of construction, $1,620; Draughtsman, $1,350; Registrar of Property, $1,350; Receiving Clerk, $1,350; 3 assistant clerks and 5 assistant registrars at $900 each, and 1 messenger. The offices are in the new city building and in appointments are second to none other in the country, with the exception of convenience and time-saving appliances, in which Providence must take the lead over all others.

The City Engineer of Providence has the highest salary of any official of that city; the list of his assistants is given on page 145, vol. 7, ENGINEERING NEWS. Of the 34 assistants there named nearly all are civil engineers, who can take a transit, level or chain and do duty in the field, or they can be equally efficient in the office. When the city of Providence wants a bridge or a sewer built it tells its Chief Engineer to build it, and that is all there is about it. There is no see-sawing about from City Engineer to independent Surveyors, to a Highway Commissioner, to contractors and so on back to the City Engineer. Will some one of our Philadelphia readers demonstrate for the general good the peculiar merits of the Philadelphia "plan" of city engineering and if it is susceptible of improvement, can such be effected, and how?

THE PREVENTION OF WASTE OF WATER.

In a paper read by Thomas Stewart, student Institution Civil Engineers, last April, and for which he received a Miller prize, we find descriptions of the methods resorted to by the authorities of many of the large cities of Great Britain in order to prevent the waste of water. Throughout the paper the term "waste" is applied to water which flows from defects in the service pipes and fittings (both material and workmanship being considered), but does not touch upon waste due to the prodigal use of water. The sources of waste are considered under the three heads: Defective water fitting, defective service pipes and defective distributing pipes.

The first division was the most fruitful source of waste, as the leaks were generally so located as to prevent inspection, and plumbers were in the habit of using fittings of inferior quality, deeming cheapness paramount to excellence, and except in the better regulated water-works this custom was general until within the past twenty-five years. The prescribing of the kinds of fittings and testing and stamping them are making great improvements in this matter, although much trouble is caused by the presence of old fittings, especially in places where there is no authority for compelling their removal. The defective fittings consisted chiefly of ground cocks and water closets supplied direct from the mains by taps. It was found that in a short time the cocks leaked, and at any time the water-closet taps allowed a continuous flow. In Glasgow they were prohibited shortly after 1860. During the summer of that year, the consumption rising at an extraordinary rate, a special inspection of the fittings in various parts of the town was made, and it was found that the common ball cocks were most wasteful; fifty-three of these being found wasting 12,500 gallons per day, and ninety-nine common cocks wasting 11,700 gallons. These investigations resulted in the following rules:

"That no common ground cock be allowed for the future to be supplied direct from the main service pipe, or from a cistern, except it be on the same floor as the tap, and that screw-down cocks only be used for this purpose."

"That no water closet be allowed to be supplied direct from the main service pipe, by any kind of tap, but be supplied from cisterns."

These rules, aided by a rigid house-to-house inspection, resulted in the saving of 5,000,000 gallons per day, or eleven gallons per head per day, and this rate continued until the Commissioners relaxed their exertions. During 1864 an examination was made of all the fittings to ascertain how many complied with the regulations, and it was found that forty-one per cent. of the whole were not in compliance, and every eighth tap was found wasting water.

The company at Norwich, acting under a special act of Parliament, reduced the consumption from 40 gallons per head per day to less than 14.5, the manager contributing one-half of this saving to the introduction of screw-down cocks, and the other half to the use of cisterns in place of cocks to water-closets and ground-ball cocks. By the same means Newcastle affected great saving; in one district, by the use of double-valve cisterns in each house, the consumption fell from 32.5 to 16.5 gallons per head per day.

Defective service pipes are not so numerous as defective fittings in proportion to the number of persons supplied; but the possibilities of locating the leaks are much fewer on account of the pipes being hidden. In Glasgow in 1876, of 10,835 complaints of deficient supply, 3,294 were found to be caused by bursted lead service pipes. The defects in lead pipes may result from want of sufficient strength to withstand the pressure, bad material, or inferior workmanship. It is difficult to unerringly detect bad material, owing to splits occuring upon the inside during manufacture. Iron pipes are generally subjected to a certain pressure before being used, and are laid under the superintendence of an officer of the water-works; while in some towns the corporation lay the pipe up to or through the walls. In increasing the supply to a town it frequently happens that the pressure is increased beyond the strength of the old service pipes, and unless there be some authority compelling their removal, the reduction of waste is much retarded.

Defects in distributing pipes are discovered by the water rising to the surface, or, when the waste is great, by lack of pressure in the immediate vicinity. Under certain conditions this waste may continue undetected for years, as shown by two cases in Glasgow where the water had burst the pipes and found a passage into the adjoining sewer, being revealed only by the falling in of the surface of the street.

In order to obtain proper service pipes and fittings, some towns keep samples to which all the materials must conform, and in addition approved fittings are tested and stamped. Cocks are subjected to a pressure about three times as great as they will have to stand when in service; water-closet cisterns are examined to ascertain if they give a flush of more than one and one half or two gallons within three or four seconds.

In 1868 double-valve cisterns were recommended for water-closets in Glasgow, and in 1878 cisterns were limited to not more than two gallons at a flush. When fittings were found wasting during the first two or three months they were removed; lead service pipe when found wasting twice during six months was removed if under ground or

in unoccupied cellars. Cocks supplied direct from the main were tested to 300 pounds; those for cisterns to 150 pounds; lavatory and other fittings to 25 pounds. The following table shows the improvement in the manufacture since the introduction of the system of testing and stamping:

Year.	Number Examined.	Number Rejected.	Per cent. Rejected.
1877	4,369	640	14.60
1878.....	20,931	1,710	6.30
1879.....	24,300	989	4.07
1880.	27,517	1,081	3.92

Service pipes of lead must be of the following weights per yard: ½-in., 7 lbs.; ¾-in., 10 lbs.; 1-in., 14 lbs.; 1¼-in., 18 lbs.; 1½-in., 24 lbs.

Cast-iron pipes must be as follows:

Diameter of pipe.	Thickness of pipe.	Depth of socket.	Length of pipe exclusive of socket.	Mean weight of each pipe.
Inches.	Inch.	Inches.	Feet.	Cwt. Qrs. Lbs.
4	5/6	3	9	1 1 25
3	4/6	3	9	1 0 17
2	3/6	3	6	0 2 4

We now come to the most important part of the paper, namely, that dealing with the

METHODS FOR DETECTING AND PREVENTING WASTE.

House-to-house inspection is in vogue in most of the larger towns in the kingdom, in some it being the only method, while in others it is used in conjunction with meters and other appliances. It consists in dividing the town into districts, appointing one inspector to each district, who inspect the premises and report any fittings that are wasting water. Notice is then served upon the tenant or owner. Within a certain time the premises are again examined, and if the repairs have not been made, water is shut off or the matter is reported to the Engineer. In Glasgow the second inspection takes place within six days of the first, and if the instructions have not been complied with the bad tap is locked up, or, when this cannot be done, the water is shut off at the stop-cock. It is not advisable in most cases to beat up the pipe leading to the tap on account of injury done to the building; but this is done when repairs are not made in a reasonable time. In 1873, in Glasgow, four inspectors were added to the force, making twelve in all, and the consumption was reduced 800,000 gallons per day as compared with the previous year.

To obviate the fact that house-to-house inspection does not localize the sources of waste, and to enable the worst districts to receive the most attention, meters have been placed on the distributing pipes supplying them. By this means—the population being known—it can be determined whether the consumption is above or below the average. The meters used for this purpose are of two kinds; those which register the quantity of water passed during a given period, and those which automatically—by means of diagrams—show the rate of consumption at any hour or part of an hour.

The paper contains quite an extended account of the Deacon system as applied to Liverpool, giving the results obtained. As this system has been fully described in our columns, we omit a review.

It has been proven that the waste from defective pipes and fittings is much greater at night than day on account of the increased pressure,* to obviate which pressure-reducing valves are so placed that the pressure on the distributing pipes will be lessened. In Glasgow the ordinary variations of pressure in the mains are from 40 pounds per square inch during the day to 85 pounds at night. The valve in one district was so adjusted that the pressure would at no time exceed 45 pounds, and the saving amounted to 12,000 gallons, or 4.25 gallons per head per day from 4 p. m. to 8 a. m. The night rate per head per day before the valve was fixed was 24.7 gallons; afterward it was 15 gallons, showing a saving of 9.7.

In concluding, the author states that each of the three systems for detecting and preventing waste—house-to-house inspection, district meters, and reducing valves—has its own applications, and neither is perfect alone, but becomes more nearly so when combined with either of the others.

The first has been found to reduce the waste to its lowest limits, but at an outlay of energy and money which few towns can afford; but it fails to detect obscure (such as underground) cases.

District meters locate the place where most waste occurs, show the locality of a leak and the saving of water effected.

Pressure-reducing valves deserve more attention than they receive. By reducing the pressure in low districts an increase will be made to those more elevated.

In closing, the author says:

"In estimating the various methods for preventing waste regard is had to the expense, and as this is the only matter on which corporations and water companies venture to decide what shall be done it is natural that at first they should select that which appears least expensive. Owing to house-to-house inspection sometimes giving good results, it is usually preferred, but the degrees of success which attend it are extremely various, and in no case can it be effective unless stringently carried out."

* [Water under a head sufficient for fire purposes will escape from a hole one one-hundreth of an inch in diameter at the rate of more than a barrel in 24 hours, and from a pin hole more than 200 gallons will flow during the same time. —Ed.]

PERSONAL.

W. P. Harris, Superintendent of the New York & Greenwood Lake Railroad, has resigned and become a Division Superintendent on the Chesapeake & Ohio road. J. H. Tenney, Assistant Superintendent of the New York & Greenwood road, has been appointed in place of Mr. Harris.

Dr. Stroussberg, the once famous railway king and bankrupt, has been busy in retrieving his shattered fortunes with street railways and cheap newspapers in Berlin, and has regained the confidence of capitalists, which he seemed never to have entirely forfeited. His latest enterprise aims at the construction of the long planned Euphrates railway.

The *Two Republics*, published in the City of Mexico, contains the following upon the subject of engineer's salaries: "As regards Mexico, we do not think engineers receive salaries here double those paid in the United States. On the railroads being constructed under Mexican management native engineers are generally employed, and we are informed that their salaries are less than what would be earned in the same positions in the United States when the difference in the value of money is taken into consideration. On the railroads being built by American companies the salaries are about the same as those paid in the United States. We do not think the inconveniences of living are greater here than they are in the new and thinly-settled portions of the United States, and when the climate and the few temptations there are here to spend money are considered we feel safe in saying that with equal salaries engineers can save more money in Mexico than in the United States. It is not supposed that men employed constructing railroads in any new country can have all the amusement and creature comforts that might be desired. Engineers have to rough it in the United States just as they do here. In the cities pleasures and comforts can be had in both countries, but these are not to be enjoyed to any considerable extent in the prairies or forests of either."

A number of Canadians, distinguished in the civic and railway affairs of the Province of Quebec, arrived in this city a few days ago in a new special car. The visitors, who are J. A. Chapleau, Premier of the Province of Quebec; E. T. Paquet, Secretary of the Province; L. A. Senecal, General Superintendent of the Province of Quebec Railway; J. B. Labelle, General Passenger Agent; A. Louthood, Secretary and Chief Accountant, and A. Davis, Mechanical Superintendent—have come mainly for rest and recreation, but the railway officials have taken the opportunity to transact a certain amount of business. They came to this city in a new palace car built for the official coach of the Province of Quebec Railway. The car is a model of beauty and comfort. It is 70 feet long, 10¼ feet wide, and 13 feet high. The exterior is painted in olive, ornamented with gold and claret. The interior is divided into three compartments—parlor, kitchen, and a sleeping-room, the kitchen being in the middle. The sides are finished with panels of black walnut, cherry, bird's-eye maple, and other ornamental woods. The ceiling is frescoed in blue, red and gold, and the corners are relieved by medallions in oil colors. A rich Axminster carpet covers the floor, and the windows and doors are curtained with brownish-gray tapestry, to match the upholstering of the Queen Anne furniture. Under the kitchen is a compartment for carrying provisions, fuel, etc. The car is supported by two trucks, each running on six steel wheels about three feet in diameter. The wheels are made after a new design of Mr. Davis, the Mechanical Superintendent of the Province of Quebec Railway, who built the car, and are riveted sectionally so that a break in any one part of the wheel will not disable the other parts.

A NEW WATER METER.

In September last a company was incorporated under the general laws of the State of New Hampshire for the purpose of manufacturing the Howe water meter. Its capital stock is $400,000, divided into 40,000 shares of $10 each, and the sole ownership to the patent of C. H. Bacon, of Boston, was purchased; thus the company acquired an undisputed title to the invention. Where a record of the minutest quantity of water used is required, it is claimed that the "Howe" is unequaled, and that it combines all the essentials necessary to a machine to satisfactorily register the consumption of water. From this cut a good idea of the construction and mode of working the meter can be obtained. Two cast-iron cylinders are placed in the form of a V joined at the bottom and arranged to oscillate on their common base, as the quicksilver contained therein causes the center of gravity of the two cylinders to change. The oscillation opens to one cylinder the ports of the supply pipe, and simultaneously shuts those to the other. The same effect is produced in

the return movement. The water from the supply pipe rushes in at the open port, forces the quicksilver from that cylinder into the other, when the center of gravity changes, and the two cylinders again oscillate, and the ports are inversely opened and shut. The cylinders oscillate about twenty degrees, and with each change is registered on a dial the amount of water which the two cylinders contain. The meter has no friction, except that of the quicksilver flowing over iron, and that occasioned by its oscillations of 20° on a composition pivot. It has no valves or nicely fitted joints, consequently the chances of getting out of repair are lessened. The Howe meter acts on the piston principle, but does not meet with the wear and tear caused by the friction of a piston, working backward and forward against a strong head of water and continually coming in contact with the particles of grit and dirt the water contains, because the quicksilver, which is the piston, adjusts itself to the cylinders. The chances for leakage are reduced to a minimum, as waterways and the absence of valves permit the passage of foreign substances which so frequently cause other piston meters to get out of order. It is claimed that the meter can be constructed and furnished cheaper than any other meter in the market, as the principal cost is quicksilver which does not depreciate with use. Registration under a small pressure is another important feature of "Howe," while its construction is so simple that it is expected the meter will soon come into general use. Through the courtesy of Mr Bacon, superintendent of the company, we are enabled to furnish these particulars of his invention.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 503.)

CLVII.—PORT HURON.

Port Huron, Michigan, in lat. 43° N., long. 82° 30′ W., is on the St. Clair River at the mouth of Black River, one mile from Lake Huron. Settled in 1828, it was incorporated as a city in 1859. In 1873 water-works were built by the city after the plans of William H. Avery, C. E., taking water from the St. Clair River and pumping directly into the mains by Holly steam pumps. A small Perkins pump was added in 1880. The ordinary pressure maintained is 30 lbs. per square inch, and the fire pressure 65 to 110 lbs. The first distribution pipes laid were of cast iron. Since 1879 Wyckoff wood pipe has been used for extensions. Nineteen miles of mains are now in use of from 16 in. to 3 in. diameter, with 109 fire hydrants, 230 gates and 1,037 taps. Lead service pipe is used.

The population in 1880 was 10,000, and the daily consumption 500,254 gallons.

The works have cost $180,000. The bonded debt is $150,000, bearing 10 per cent. interest.

The expenses in 1880 were $5,982.32 and the receipts $9,080.12.

The works are managed by three water commissioners. William H. Avery has been the Chief Engineer since 1873, and was Superintendent from 1877 to 1881.

Lewis Atkins has been Secretary since 1873 and is now the Superintendent also.

CLVIII.—LINCOLN.

Lincoln, Massachusetts, in lat. 42° 23′ N., long. 71° 14′ W., is 14 miles N. W. of Boston, in a hilly, agricultural region. It was settled in 1747, and incorporated as a village in 1754.

In 1875 water-works were built by the town, after the plans and under the superintendence of Marshall M. Tidd, C. E. The supply is taken from Sandy Pond, a natural lake of 152 acres area, and lifted by a Worthington duplex pump of 312,000 gallons capacity per day, through 6 and 8-in. pipe, into a reservoir built in excavation and embankment, and holding 130,000 gallons.

Distribution is by wrought-iron and cement pipe, of which 3½ miles are in use, with 11 fire hydrants and 23 taps.

The population in 1880 was 907. The consumption is not known.

The works cost $33,000, and there is a bonded debt of $30,000. The annual cost of maintenance is about $500. The works were made over to the water takers to run for their own use and pay their own expenses, and they are so operated, the water takers dividing the cost of operation, which amounts to about $10 per annum for each faucet. J. L. Chapin has been the Superintendent from the beginning.

CLIX.—MEMPHIS.

Memphis, Tennessee, in lat. 35° 8′ N., long. 90° 3′ W., is on the Mississippi River, just below the mouth of Wolf River. The city stands on the fourth Chickasaw Bluff, about 35 ft. above the highest floods. The ground falls from the summit ridge to the Mississippi on one side and the Bayou Gayoso on the other.

It was laid out in 1820, and incorporated as a city in 1827.

In 1872 water-works were built by a private company, with A. R. Ketcham as Consulting Engineer, and Galen W. Pearsons, C. E., as Constructing Engineer, taking water from Wolf River, 2 miles north of the centre of the city. At the foot of the bluff, two rows of oak piles, 12 to 14 in. in diameter and 30 ft. long, were driven 18 ft. into the ground, for 150 ft. along the river. The rows were 8 ft. apart and the piles 4 ft. apart in the rows. They were connected by longitudinal timbers, along which 5-in. sheet-piling was driven. Outside of this, a well 18 ft. in diameter, with 21-in. brick walls on a timber shoe, was sunk 23 ft. by excavating from the inside and setting the curb through gravel and quicksand, very difficult to handle. A filtering trench was formed between the sheet-piling, 3½ ft. wide and 4 ft. high, with brick side-walls and plank top and bottom, and covered with 5 ft. of gravel. A crib of timber, 60 ft. wide, was extended into Wolf River and filled with gravel, and covered with plank and gravel.

From the outer wall and gravel crib a tunnel, 130 ft. long and 12 ft. below low-water mark, was run into the bluff to a plate-iron well 18 ft. in diameter and 60 ft. long, extending down from the surface. The excavation was made 24 ft. in diameter for 30 feet down and then reduced to 15 ft. diameter and carried down with sloping sides for 16 ft., being then 10 ft. in diameter. The iron tube was then built up on the shelf and suspended by screw rods from a truss overhead and lowered by them as successive plates were added to the top.

Eight pumps of 20-in. diameter and 24-in. stroke placed in the bottom of the well, and drawing water through a 20-in. pipe laid in the tunnel to the outer well and crib, forced the water directly into the mains. The pump rods extended to the top of the well and were there operated by cranks on a shaft geared to a Holly engine with two cylinders of 21-in. diameter and 33-in. stroke. Two rotary pumps at the ground level took their supply, when they were needed for fire service, from a reservoir of 3,000,000 gallons capacity, built near the engine house and filtered from the other pumps.

The company laid 17 miles of pipe at that time, the entire works costing $472,278.39. The supply furnished by the company was not satisfactory as to quantity or quality, the filtering apparatus proving ineffective and the machinery insufficient. In 1880 a new company was organized, which purchased the existing works for $200,000 and reconstructed them.

A 24-in. pipe extends from the river through a tunnel 200 ft. long, to a brick well 18 ft. in diameter and 61 ft. deep, resting on a cast-iron shoe. At the bottom of the well are four double-acting plunger pumps of 16-in. diameter and 36-in. stroke, with connecting rods extending to the top of the well, to two pairs of steam cylinders of 24-in. diameter and 36-in. stroke, the piston rods of each pair being connected to cranks on a fly-wheel shaft. The engines are after the designs of H. F. Gaskill, and were built by the Holly Manufacturing Company. There is an air chamber on the suction pipe, and one on each discharge pipe. The engines pump directly into the mains.

Distribution is by cast-iron pipe, of which about 20 miles are laid, with 200 fire hydrants, 3,000 taps and a few meters.

The population in 1880 was 33,593, and the daily consumption was stated to be 5,000,000 gallons.

The capital stock of the company is $350,000 and the bonded debt $100,000, bearing 6 per cent. interest. The expenses for maintenance in 1880 were about $25,000 and the receipts $45,000. Water is furnished to the city for public buildings and for fire purposes without charge.

T. J. Latham is the President and W. L. Cameron Secretary of the company.

CLX.—SALT LAKE CITY.

Salt Lake City, Utah, in lat. 40° 46′ 2″ N., long. 111° 50′ 37″ W., on the Jordan River, 4,320 ft. above the sea, is at the eastern base of the Wahsatch Mountains near a point that projects into Salt Lake valley. A portion of the city is built on the mountain bench, the remainder on a nearly level plain. It was settled in 1847 and incorporated as a city in 1851. The streets are all 132 ft. wide and are at right angles to each other, making uniform blocks of ten acres area each.

Water-works were built by the city in 1874, after the plans of Thomas W. Ellerbeck. Water is taken from City Creek, a cañon stream north of the city, with 30 square miles water-shed, and fed by mountain springs and melting snow. The stream supplies irrigating water during the summer for the greater part of the city, a current of water being carried along the gutter on each side of the street. A timber dam across the creek diverts its waters into a flume of redwood, 2½ by 4½ ft. and 100 ft. long, leading to two tanks, one 29½ by 16 ft., the other 28 by 15½ ft., both being 10 ft. deep. These tanks are 180 ft. above the northern part of the city and 225 feet above the southern and western portions. The actual pressure in the pipes is 70.01 lbs. per square inch.

Distribution is by cast-iron pipe, of which 11 miles are laid, of from 20 to 4-in. diameter, with 128 fire hydrants. The number of the taps is not furnished.

The population in 1880 was 20,768, and the daily consumption is estimated at 250,000 gallons. The works have cost $250,000. The total receipts to date have been $33,892.35. The expenditures in 1880 were $20,902.73, and the receipts $8,509.60. The works are managed by the city council and a superintendent. The latter position has been filled by T. W. Ellerbeck, F. Little and the present incumbent, G. U. Ottinger.

CLXI.—WALTHAM.

Waltham, Massachusetts, on the Charles River, ten miles west of Boston, is principally on one street a mile long, in a level plain of about 2½ square miles area, surrounded by high, wooded hills. The river affords water power for manufacturing purposes. The first cotton mill was erected there in 1814. The town was incorporated in 1838.

Water-works were built by the town in 1873, after the plans of Edward Sawyer, C. E., and under the superintendence of Joseph H. Curtis, C.

* Copyright 1881.

E., taking the supply from a basin 8 ft. deep, on the bank of the Charles River, constructed by making an excavation into a gravel knoll on one side, and on the other three sides, inclosing a portion of the river, by a coarse gravel embankment some 60 ft. in width. During the construction of this basin it was necessary to pump the inflowing water at the rate of 4,000 gallons per minute. The natural level of the water in the basin is slightly above that of the river, and its temperature is more uniform throughout the year. Experiments made by Prof. W. R. Nichols in 1876 led to the conclusion that a greater portion of the yield came from the ground water than from the river by percolation through the gravel.

A conduit 65 ft. long conveys the water from the basin to a pump-well, whence it is pumped by two Worthington compound engines, with high-pressure steam cylinders of 14-in., low pressure 30-in., and water cylinders 14-in. diameter, all of 18-in. stroke. One engine was erected in 1873 and the other in 1880. They deliver into a reservoir 280 by 280 ft., with semicircular ends, built in excavation and embankment, 165 ft. above the pumps and 138 ft. above the highest street level. Distribution is principally by wrought-iron and cement pipe. Recent extensions are of cast-iron pipe. Some trouble has been experienced with the former pipe of 4-in. and 6-in. diameters. There are 23.33 miles of pipe in use, of from 16-in. to 4-in. diameter, with a few short lines of 2-in. cast-iron. There are 130 fire hydrants, for which the town pays $25 per annum each. The number of taps is not furnished. Eight meters are in use.

The population in 1880 was 11,711 and the daily consumption 411,000 gallons.

The works cost to Jan. 1, 1881, $305,722.13.

The expenditures in 1880 were for interest $20,-119 and for maintenance $4,984.39. The receipts were $25,132.86.

The works are managed by three water commissioners, one of whom is elected annually.

The Superintendent is C. F. Parks.

CLXII.—DECATUR.

Decatur, Illinois, in lat. 39° 45′ N., long. 89° W., is on the right bank of the Sangamon River in a flat bottom land, the soil of which is underlaid with gravel.

In 1871 water-works were built by the town, under the superintendence of Kinsey and Mahler, civil engineers, taking water from the Sangamon River, and pumping directly into the mains by two Cameron pumps with steam cylinders of 18-in. and water cylinders of 12-in. diameter. A Holly rotary pump aids in obtaining fire pressure.

A 22-in pipe conveyed the water from the river to the pump well. Afterwards a crib was sunk 600 ft. long. 10 ft. wide and 6 ft. high and arched over, into which the surrounding water filters, and is led to the pump well. A pipe connects with the river, but is used only in very dry seasons.

Distribution is by cast-iron pipe, of which 97 miles are in use, with 100 fire hydrants and 385 taps.

The population in 1880 was 9,449 and the daily consumption 250,000 gallons.

The works have cost $145,000. The annual cost of maintenance is $5,000.

Sullivan Burgess was the Superintendent and Engineer from 1871 to 1880. The City Clerk, G. P. Hardy, and Superintendent of streets now attend to the management of the water-works.

CLXIII.—LOCKPORT.

Lockport, New York, in lat. 43° 12′ N., long. 78° 50′ W., is on the Erie Canal, 20 miles east of Niagara Falls, in a precipitous limestone region. The canal here descends 60 ft. by five locks in succession. There is a flow of 35,000 cu. ft. per minute in the canal, one-fifth of which is used for navigation, and the remainder is utilized for water power. The city is on two planes, the lower nearly level, the upper 62 ft. above it, and rising slightly back from the bluff. The city was incorporated in 1865. Water-works were built in 1868 by the Holly Manufacturing Company, taking the supply from the canal above the locks, pumping directly into the mains by four double-acting pumps, driven by water power, under 52 ft. head. The water for power and supply is led to the wheels and pumps through a tunnel 500 ft. long through rock. Its dimensions are 9 by 10 ft. The ordinary pressure maintained is 100 lbs. per square inch; fire pressure, 150 lbs.

Distribution is by cast-iron pipe. Flanged pipe was first laid, since replaced by the ordinary form of hub and spigot pipe. Seven miles are in use, of from 12-in. to 4-in. diameter with 133 fire hydrants, 36 gates and 250 taps.

Service pipes are of wrought-iron gas-pipe. The population in 1880 was 13,522 and the daily consumption about 800,000 gallons. The Holly Manufacturing Company own and operate the machinery, the city furnishing the pipes and hydrants. No statement of cost, receipts or expenses is furnished. H. F. Gaskill is the superintendent of the company.

CLXIV.—IRONTON.

Ironton, Ohio, in lat. 38° 40′ N., long. 82° 30′ W., is on the Ohio River, in the centre of the Hanging-rock iron region. The city is on a high bluff, and at the foot of lofty hills. Settled in 1849, it was incorporated as a village in 1852 and as a city in 1865.

Water-works were built by the town in 1870, on the plans of the Holly Manufacturing Company, taking the supply from the Ohio River and pumping directly into the mains by 6 single-acting pumps of 14-in. bore and 18-in. stroke, operated by a Holly engine and 2 rotary pumps for fire pressure. The highest point supplied is 85 ft. above the river. An ordinary pressure of 30 lbs. per square inch is maintained and a fire pressure of 80 lbs.

Distribution is by cast-iron pipe of from 12-in. to 4-in. diameter; 8 miles are in use, with 114 fire hydrants. The number of taps is not given.

The population in 1880 was 9,000 and the daily consumption 1,500,000 gallons.

The works have cost $160,000. The expenses in 1880 were $7,500 and the receipts $10,000.

The works are managed by three trustees. Edward Lawton is the Superintendent.

CLXV.—WINSTED.

Winsted, Connecticut, in lat. 41° 55′ N., long. 73° 7′ W., on Mad River, comprises two villages connected by a winding street three miles long following the river, along which the business portion of the town is built, the residences generally occupying the hill-sides farther back. It was settled in 1770. In 1861 water-works were built by the borough of Winsted, after the plans of A. Chamberlain, taking the supply from two natural lakes, one of 390 acres area, increased to 500 acres by a dam 4 ft. high, the other of 100 acres area. The dam is of earth. In 1874, two waste-weirs of masonry, with concrete overflow, were built. From the lake, which is 220 ft. above the lowest portion of the town, the water is conveyed by 1,760 ft. of wrought-iron and cement pipe, and 880 ft. of cast-iron pipe, to the distribution, which comprises about 10 miles of pipe, half of which is of wrought-iron and cement and half of cast-iron pipe. There are 85 fire hydrants. The number of taps is not accurately known.

The population in 1880 was 4,500. The consumption is not stated.

The works have cost $100,000. The outstanding bonded indebtedness on May 1, 1881, was $25,000.

The receipts and expenses for five years past have been as follows (the years ending April 20):

	1877.	1878.	1879.	1880.	1881.
Receipts.	$3,866.36	$4,467.94	$4,485.23	$4,490.72	$4,704.94
Expenses of maintenance.	2,044.90	3,931.59	3,010.01	1,064.64	2,066.47

The annual interest on the bonds is $1,500 additional.

The works are managed by three water commissioners, one of whom is elected annually. Henry Hungerford Drake is the Superintendent.

(TO BE CONTINUED.)

The receipt of statistics as follows is acknowledged with thanks:

From G. P. Hardy, City Clerk, statistics and rates of Decatur (Ill.) Water-works. From G. M. Ottinger, Superintendent, statistics of Salt Lake City Water-works and water rates. From Edward Lawton, Superintendent, statistics of Ironton (O.) Water-works. From C. F. Parks, statistics of Waltham (Mass.) Water-works. From H. Hungerford Drake, statistics, water-rates, and annual reports for 1877 to 1881, of West Winstead (Conn.) Water-works. From T. J. Latham, President, history, statistics, charter and water rates of Memphis (Tenn.) Water-works. From H. F. Gaskill, Superintendent Holly Manufacturing Co., statistics of Lockport (N. Y.) Water-works. From Thomas W. Baldwin, City Engineer, a full set of Reports of the Bangor (Me.) Water Board for 1877 to 1881.

From Edward S. Frost, Secretary and Treasurer, Statistics and Water Rates of the Akron, Ohio, Water-Works Company; from an anonymous source, History of Bridgetown, N. J., Water-Works; from J. L. Chapin, Superintendent, Statistics of Lincoln, Mass., Water-Works; from the Superintendent, James Wyatt, Statistics of Nashville, Tenn., Water-Works; from C. Baillargè City Engineer, History of Quebec, Canada, Water-Works, and Reports of G. R. Baldwin, 1848, T. C. Keefer, 1860, G. R. Baldwin, 1865, and C. Baillargè, 1881, on the Water Supply; from H. W. Lake, Secretary, Statistics of Leadville, Colorado, Water-Works; from W. H. Avery, C. E., Statistics of Port Huron, Michigan, Water-Works.

CORRESPONDENCE.

CALCULATION OF EARTHWORK.

SAN MIGUEL, Mex., Nov. 12.

EDITOR ENGINEERING NEWS:

I desire to call the attention of your readers to a matter of calculating earthwork.

Take, for example, the problem given in Henck's field book, page 103. Here we have a section of the following dimensions: Length, 100 feet, width of road-bed, 18 feet, with side-slopes 1½ to 1. One end area has a center height of 13.6 feet; right side height 10.0, and distance out 24 feet; left side height, 8.0 feet, and distance out 21 feet; area is 387 square feet. The other end area has a center height of 8.0 feet; right side height 12 feet, distance out 27 feet; left side height 4 feet, distance out 15 feet; area is 240 square feet.

According to Mr. Henck's formula, he finds the contents to be 32,820 cubic feet. On page 110 he states that if the diagonal were reversed (am I to understand by that, if one of the areas were reversed) the contents would be 29,600.

Now let us calculate this same section by the prismoidal formula. A center area would have a center height of 10.8 feet; right side height 11 feet, distance out 25.5 feet; left side height 6 feet, distance out 18 feet, area 311.4. Without giving process of calculation, I find contents to be 31,210 cubic feet.

Now, the singular part is, if the average of Mr. Henck's two calculations be taken, it gives precisely the same result, thus: 32,820 + 29,600 = 62,420. divided by two equals 31,210.

Now, I desire to know which is correct, and why. This is a matter of importance, as a differ-

ence of 1,610 cubic feet is no small item, and would amount to considerable in a long distance.

Yours truly, FRANCISCO CHAVEZ.

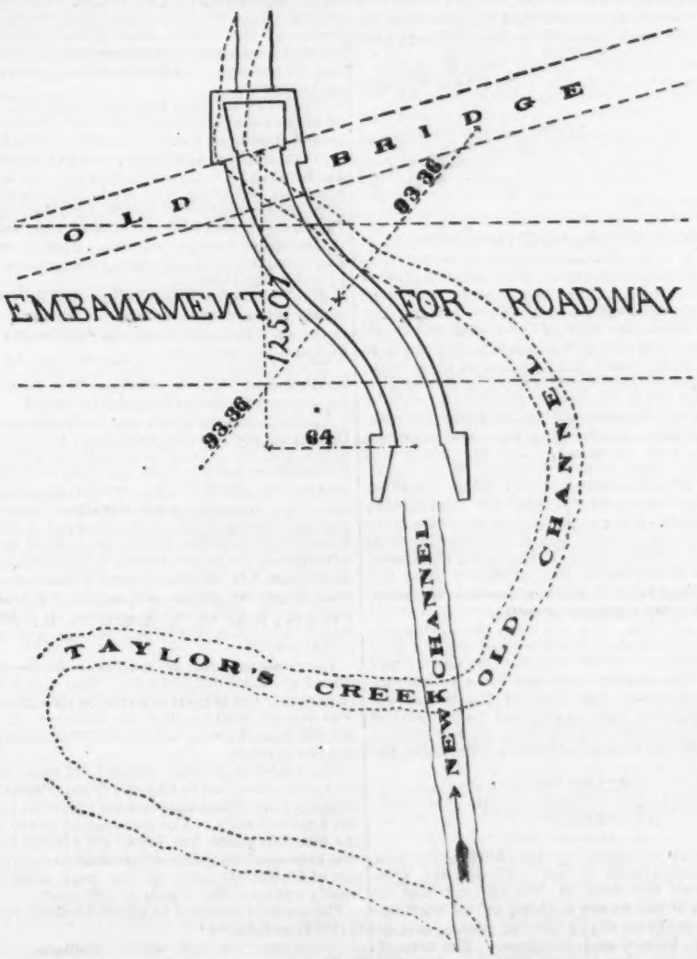
A REVERSE CURVE INSTEAD OF A SKEW ARCH.

NEWPORT, Ky., Nov. 29, 1881.

EDITOR ENGINEERING NEWS:

Accompanying I send a sketch of the foundations of an 18-ft. arched culvert which I designed and constructed near here several years ago.

The only peculiarity of the design is the method of obviating the necessity for a skew arch by means of a reversed curve.



A REVERSE CURVE INSTEAD OF A SKEW ARCH.

The banks of the creek being high and abrupt necessitated the location as shown; a straight line connecting the two ends, making an angle of 62° 54′ with the axis of the road, the skew being 64 ft. in 125.07.

The work was constructed with ordinary limestone rubble work in cement.

The appearance inside the culvert is very singular, there being no straight lines.

I believe the plan has the merit of novelty; at least I have never seen or read of a precedent. With the hope that the idea may possibly be of utility elsewhere, under similar conditions, I send it. Respectfully, B. R. MORTON, C. E.

ENGINEERING IN MEXICO.

IN CAMP, near Rancho Colorado, Nov. 21, 1881.

EDITOR ENGINEERING NEWS:

Noticing the many complaints of engineers engaged on Mexican railways, about the irregularity attending the arrival of ENGINEERING NEWS, I am glad to say I have not missed one single number since arriving here in April last. My headquarters have been on a constant move, and most of the time in the wildest parts of the Sierra Madre, but ENGINEERING NEWS has always found its way to me and been a source of pleasure, while other papers remained away. Of course I do not intend to pay a tribute to the alacrity of the Mexican mail service. In a country where people depend for rapid transit and the carrying of freight almost wholly upon the uncertain disposition of an inferior class of mules, one cannot expect to hear from the outside world promptly. But this company (the Mexican Central) has its own carriers and the mails are distributed by them directly after being landed at Tampico.

The more we learn of Mexican life and customs the more marked seems the difference with other civilized countries. It is certainly strange that Mexico, being the first discovered, should be the last in civilization, progress and spirit of enterprise of all America. Our present invasion, peaceful though it is, will cause a great change in the internal affairs of Mexico. The abominable land system of lords and tenants, not a particle better than in Ireland, will have to be abolished from the start, and the inadequate way of taxation will likewise undergo a complete change. The country must be thrown open to immigration, and immigrants will come and settle in this genial climate as soon as the land-owners show a more liberal dispcsition to sell parts of their property; at present this disposition is decidedly the other way; enormous estates exist, many covering hundreds of square miles of territory of idle soil that might be tilled, but those who own, hold on to what they have, and all look forward to enriching themselves without knowing exactly how it is to be done but by profiting from the railroads.

Much has been said and written about Mexico; much that is true and more that is false. But great as is the capital so generously pouring in upon this country, it is not half sufficient to open up the numerous hidden resources of which history has kept a record since the days of the Montezumas. We only have to realize that here we are still a century behind and be moderate with our appliances at modernizing. The people are not inimical to our enterprises, though they may view them with suspicion; but the report which has generally gone abroad, that they are more or less of the cut-throat pattern, is altogether wrong. I was surprised to find them peaceable, honest, open-hearted and hospitable.

I would gladly write you more fully, but our busy life leaves but few moments of leisure. I have been locating the line through the ragged parts of the Sierra Madre, using 2½ per cent. maximum grade and 15° minimum curve for 25 meter chords. I am now on the western slope of the Sierra, running a preliminary toward Valle del Maig, with a view of improving on the location.

Very truly, MAX E. SCHMIDT, C. E.

SANITARY INSTITUTE OF GREAT BRITAIN.

At an examination held by the Sanitary Institute of Great Britain, on Nov. 3 and 4, eight candidates presented themselves. The Institute's Certificate of Competency as Local Surveyors was not awarded, but the Institute's Certificate of Competency as Inspectors of Nuisances was awarded.

The following questions were set to be answered in writing on the 3d, and the candidates were examined *viva voce* on the 4th:

SURVEYORS.

State the conditions under which the discharge of sewage matter into streams is prohibited by the Rivers Pollution Prevention Act, and also the conditions under which such discharge is not prohibited by this act. Explain what is the meaning of a "stream" under this act.

Is foul air more likely to be found in the sewers of a town or of a village? and why? What are the best means of preventing its formation?

What are the relative advantages and disadvantages of pipe and brick sewers? How can the objections to pipe sewers be overcome? Illustrate your answer by sketches.

How much sewage would pass in twenty-four hours through a sewer of 8-in. diameter, laid at an inclination which would give a velocity of 3 ft. per second, and what population would this sewer suffice for in a town with a public water supply where the rain and surface water, other than that from the roofs and paved yards of houses, is carried off by a separate system? Give your calculation in full.

Draw the scheme of drainage you would suggest on the accompanying plan of a dwelling-house, and give sketches of the various traps you would employ, of the method of laying the drain, and of its connection with the sewer, accompanied by a short description of the mode of executing the work you propose.

If asked to advise as to the water supply of a town, what are the chief points to which you would direct your attention, if the supply is to be derived (*a*) from wells, (*b*) from streams?

Describe the construction of an ordinary rain gauge and the precautions which should be taken in fixing it. Give instances of the amount of annual rainfall in various places. What weight of water does one inch of rain on an acre represent?

What materials are used for the construction of cisterns and water pipes, and what are the advantages and disadvantages of each?

Explain what is meant by ventilation of rooms. How far does the size of a room affect the question? Given a room 12 ft. by 10 ft. by 10 ft. high, occupied by three persons, what means of ventilation would you adopt? To what extent will they be efficient?

Write a specification for the construction of a macadamized road, 40 ft. wide with 6 ft. footway on each side, across an estate on a clay soil, with cross section, and estimate of cost per foot run.

INSPECTORS.

Mention the principal acts relating to the public

health, and state briefly their most important provisions.

What is the order of procedure prescribed by the Sale of Food and Drugs Act in obtaining for analysis samples of articles suspected of being adulterated?

Describe some simple means of ventilating sleeping-rooms which you think would be efficient. What do you consider overcrowding?

What are the physical characteristics of good drinking water?

A house is found to be unhealthy, there are occasionally (not always) offensive smells, perceived both in the basement and in the upper rooms; what is the most likely cause of this, and how would you proceed to investigate it?

How should the soil pipes, sink pipes and overflow pipes of a dwelling be dealt with so as to prevent any danger to the inmates? What do you consider a proper fall for a 6-in. house drain?

How would you proceed to disinfect a house in which a case of typhus fever or small-pox had occurred?

In the inspection of a slaughter-house, to what points would you specially direct your attention? What are the requirements of a properly-constructed slaughter-house?

ANNUAL REPORT OF THE CITY OF DENVER, COL.

On a prospective change in the office of city engineer, the late incumbent states as follows:

It will perhaps be recognized by all, from what I have called to mind, that the duties of your city engineer in the future cannot be otherwise than onerous and responsible. Not knowing at this time who he may be, I bespeak for him the same generous good will and support you have given me.

One thing especially I would call to your notice. In this office, above all others in your gift, frequent changes should be avoided, and in the shortness of the term prescribed lies the danger of incompetency securing the position.

The work requires skill and engineering talent to a considerable degree, yet few professional men care to be subjected to the chances of yearly elections, and abide, too often without regard to their qualifications, the decisions of political caucuses.

My immediate recommendations to your honorable body are as follows:

As to the City Engineer's office, make up your mind that the public engineering of a city of 50,000 inhabitants, growing as is Denver, can no longer reasonably be expected to be so nearly self-sustaining as to cost the city no more than four or five thousand dollars per annum with economical results. The work of the city now crowds the office. Much work is left undone that should be done. Another clerk and a draughtsman can be constantly employed with profit to the city.

Strict police surveillance should be held over all excavations in the thoroughfares, and no longer should be enacted the farce of putting the engineer's office to vast labor and considerable expense in issuing permits to excavate in streets under strict rules that the police fail to enforce.

Here, again, is large work for the engineer to keep record of all pipes or other construction placed in the streets. Else what knowledge has the city government of what occupies its thoroughfares, or what barriers to some future improvements of great public necessity may be entailed by the indiscriminate occupation of the ground. Pipes for all uses and without regard to plan or system, heretofore, and until the year just past, have been freely placed in the streets of this city.

This task alone demands the entire time of one assistant.

The sewers must not be left to themselves. In the great rush of work which crowds every branch of the engineering department no systematic flushing of the sewers has been followed. Our sewer system is indeed constructed with special reference to this end, and I have designed a flush valve for use in the flushing cisterns, but beyond determining the fact that it can be made to work, and undoubtedly with excellent effect, the construction of the valves has been for the time overlooked.

The flushing of the sewers should be no longer delayed, however, nor regular inspections of the various laterals now in operation, and it is my recommendation that pending the completion of the flushing tanks, every lateral to be flushed at least once every two days by water from a portable tank. New sewer districts should also be formed at once and the drainage work extended. Our iron bridges should also receive attention and consideration.

If I have succeeded in giving any satisfaction under the responsibilities which of late have divided my time and prevented my giving much of my personal service to the city, it must of necessity follow that it is largely due to the able assistance I have had. This I desire to acknowledge and return thanks for.

Mr. H. F. Merryweather, C. E., has been an able and most industrious assistant in general charge. Mr. J. B. Hunter has been an invaluable aid in field service. Mr. Wilcox, as chief of sewer-inspectors, has been attentive and vigilant, as indeed have all the other employés, as I believe. I hope that such of them as desire it will be retained in the service under my successor, and indeed I imagine that for some time, at least, that will be found almost a necessity. Very respectfully submitted,

H. C. Lowrie, City Engineer.

We commend what Mr. Lowrie says on the changes of city officers as worthy of consideration in towns of growing population. The condition of the sewers in Denver City in the early future may be imagined if designed and carried out by the method here stated.

SLOW-BURNING CONSTRUCTION.

So long as wood must be used for floors and roofs there can be no such thing as fire-proof buildings. It is therefore proposed by one of the leading fire insurance companies that all new structures, and particularly factories and shops where wood is to be used, shall be made fire-resisting or slow-burning. The plan suggested is worthy of attention, because it often happens that, if the fire can only be confined to the interior of the building for even a few minutes, much property, and perhaps many lives, can be saved. For the floors it is proposed to use heavy timbers 30.5 centimeters by 30 centimeters (12 by 14 in.), and on these to lay matched planks 7.6 centimeters (3 inches) thick. Over these planks is to be a layer of roofing-felt or mortar, and in this mortar is to be bedded flooring-boards of the usual thickness. Such a floor would burn, but so slowly that fire would be a long time in working its way through. The aim is to gain time, for time is the one element of safety at all fires. For the roof, the supporting beams are to be of the same size, and the top is to be of matched planks 7.6 centimeters thick, and covered on the outside with any form of roofing that may be desired. The ends of the beams are to pass through the outer walls, and to be finished as brackets to support the planking that is carried to the ends of the beams.—*Century Magazine for December.*

OUR ANTHRACITE FUEL AND ITS EXHAUSTION.*

The territory occupied by the anthracite coal fields of Pennsylvania is but a diminutive spot compared with the area of bituminous coal in Pennsylvania alone, to say nothing of its vast extent in other portions of the United States, and in Great Britain, France and Belgium. The area of the anthracite of the United States is but 470 square miles, not one-twentieth the size of Lake Erie, while the wide-spread bituminous coal fields cover twice the area of our four great lakes. But the comparison with the bituminous area is deceptive, unless the relative thickness of the two is taken into consideration. If the anthracite beds were spread out as thinly as those of the bituminous region, they would cover eight times their present area, or 3,760 square miles.

The number and extent of the anthracite coal beds show a total thickness of 107 feet, distributed in fifteen workable beds, interstratified with a full mile in thickness of rock and shale, and are mainly confined to one-sixth of the area of the four mountainous counties of Luzern, Schuylkill, Carbon and Northumberland, in Pennsylvania.

The *fearful loss* of good material involved in mining and preparing anthracite, though greatly to be deplored, seems to be almost inevitable. The disposition of the coal in large, solid beds, and its highly inclined positions, involves strong supports to keep the superincumbent mass from crushing and closing the avenues to the mines; and these supports must consist of massive pillars of the solid coal itself. Wooden props, however ponderous and strong, can only be used for the minor supports. Some of this pillar coal is ultimately removed, but much of it is inevitably lost, especially in the larger beds, which frequently range from 20 to 40 feet in thickness, and are often inclined at an angle of from 40 to 70 degrees.

It is estimated that not more than 66 per cent. of the coal is ever taken out from the mines. That which is brought to the surface is run through a huge structure from 80 to 100 feet high, called a "breaker." There are over 300 of these immense buildings in the anthracite region, costing on an average $50,000 each, or an aggregate of $15,000,000. To the top of these the coal is hoisted, and then descends through a succession of rolls and screens, emerging at the bottom in a series of assorted sizes, from huge blocks of lump coal to unmerchantable dust, which forms a grievously large proportion of the whole. This process involves a loss of good coal, equal to 20 or 25 per cent. of the entire quantity mined. The coal wasted in mining, say 40 per cent., and in preparing, 25 per cent., is a total loss to landowner, miner and shipper.

Plans for utilizing the waste coal dirt, or culm of anthracite colleries, have been frequently suggested, but none have come into general use. The Anthracite Fuel Company, on Port Ewen, on the Hudson, in 1877, used 90 per cent. coal dust and 10 per cent. fuel pitch, and made 300 tons of fuel per day, consuming over 50,000 tons of culm. The Delaware & Hudson Company also use at their mines 60,000 tons per annum. They now ship all their coal down to pea sizes, and consume the culm in generating steam.

The Philadelphia & Reading R. R. Co. has recently introduced a method of burning coal dust in the furnaces of its engines, and the plan appears to meet with success.

The amount of water which drains into a vein is enormous. On an average five tons of water are hoisted for every ton of coal raised.

The bituminous coals, particularly those of the United States, are not subjected to these serious losses, and are quite cheaply mined and prepared. No breakers are required, as the only division is into coarse and fine coal, which are easily separated by screens; and the fine coal can be readily converted into coke, making a better condensed fuel than the coal in its natural shape. The bituminous veins are nearly horizontal and rarely more than 6 ft. thick, so that it not necessary to have extensive pillars, and as the coal is above the water level, with shallow basins, it is not necessary to put up extensive hoisting and pumping machinery.

The total amount of coal still to be mined is stated at 26,361,076,000 tons. The total waste as experience has shown is equal to two-thirds of the coal deposit, and reaches the amount of 17,574,000,666 tons, leaving us only 8,787,0075,000 tons to send to market.

The tables show that 360,017,817 tons have been sent to market in the 58 years from 1820 to 1878, inclusive. Our consumption now amounts to 20,000,000 tons annually. The increase of production for the past ten years has been 187,112,857 tons. At this rate we shall reach our probable maximum output of 50,000,000 tons in the year 1900, and will finally exhaust the supply in 186 years.

The present product of the anthracite coal fields is (1878) as follows:

	Collieries.	Tons.
Southern	40	1,229,081
Middle	180	9,529,525
Northern	128	7,680,900
Total	348	18,439,506

Partially successful experiments have been made to use petroleum as a substitute for coal to some extent. But is it not already evident, under the reckless prodigality of production, that this occult and mysterious supply of light, heat and color will be exhausted before the anthracite, and can, at best, only temporarily retard the consumption of the latter?

The question of the exhaustion of our coal supply is scarcely more at the present time than a curious and interesting calculation. It has not yet become so grave and portentous as in Great Britain, where a commission, with the Duke of Argyle, Sir Roderick Murchison and Sir W. G. Armstrong at its head, was recently appointed by Parliament to ascertain the probable duration of the coal supplies of the country. There it is serious indeed; for when Britain coal fields are exhausted her inherent vitality is gone, and her world-wide supremacy is on the wane.

In the twenty-three years from 1854 to 1876, inclusive, she produced the enormous quantity of 2,210,710,091 tons of coal; and exported only 222,196,109 tons—say ten per cent—consuming the rest within her own borders.

The average increase of her annual output has been 3½ per cent.

Our anthracite product, compared with the coal

* From a paper by P. W. Sheafer, read before the American Association for the Advancement of Science, August, 1880.

product of Great Britain, is so small as to really seem insignificant. The English commission counts as available all coal beds over one foot thick—we count nothing under two and a half feet thick, nor below 4,000 feet in depth—showing a net amount in the explored coal fields of 90,207,285,398 tons; estimated amount in concealed areas, 56,273,000,000 tons; total, 146,480,285,398 tons, distributed as follows:

	Explored.	Unexplored.	Total.
England	45,746,930,555	56,246,000,000	101,992,930,555
Wales	34,461,208,913	.....	34,461,208,913
Scotland	9,843,465,930	No estimate.	9,843,465,930
Ireland	155,680,000	27,000,000	182,680,000
Total	90,207,285,398	56,273,000,000	146,480,285,398

The exhaustion of this magnificent mass of coal at this present rate of increase, viz.: three and a half per cent. per annum, is estimated by Professor Jevons as follows:

1876, actual output	133,300,000 tons.
1886, estimated annual output	186,600,000 "
1896, " " "	261,200,000 "
1906, " " "	365,700,000 "
1916, " " "	512,000,000 "
1926, " " "	716,800,000 "
1936, " " "	1,003,500,000 "

Thus in sixty years the output would be nearly eight times the present amount, and about one-fourth of the total amount to be found in Great Britain.

We have about 340 collieries and produce 20,000,000 tons per annum, or about 60,000 tons each. Great Britain has nearly 4,000 collieries and mines 132,000,000 tons, or 33,000 tons per colliery.

Most of the anthracite mining in the United States is now done at a less depth than 500 feet vertical; but as the coal nearer the surface becomes exhausted, the mine must go deeper and become more expensive. The coal resources of Great Britain are all developed now, and in process of depletion, while in this county, when our 470 square miles of anthracite are exhausted, we have more than 400 times that area, or 200,000 square miles, of bituminous coal from which to supply ourselves and the rest of mankind with fuel. The coal product of the world is about 300,000,000 tons annually. The North American continent could supply it all for 200 years. With an annual production of 50,000,000 tons, it would require twelve centuries to exhaust the supply. But with a uniform product of 100,000,000 tons per annum, the end of the bituminous supply would be reached in 800 years.

ANTHRACITE COAL AREAS OWNED BY THE SEVERAL COMPANIES, AND THE PER CENT. OF THE WHOLE IN TONS.

NAME OF COMPANY.	Schuylkill.		Middle.		Wyoming.	
	Acres.	P.c.	Acres.	P.c.	Acres.	P.c.
Lehigh Valley	.....	...	18,036	24	6,934	4
Lehigh & Wilkes-Barre	7,000	8	7,000	8	7,400	5
Delaware & Hudson	.....	...	.....	....	20,042	12
Del., Lacka. & Western	.....	...	.....	....	3,500	3
Pennsylvania Coal Co	.....	...	.....	....	10,000	6
Phil. & Read. C. & I. Co.	65,306	70	23,250	32	.....	....
Pennsylvania R. R. Co	6,000	6	9,000	9	5,823	....
Girard estate	.....	....	6,000	8	.....	6
Gilbert & Co.	.....	....	1,373	2	.....	....
Alliance Coal Mining Co.	3,172	3	.....	....	.....	....
All others	11,362	13	15,981	17	73,021	64
Total	93,440	100	80,640	100	126,720	100

RAILWAY PROGRESS IN GREECE.

The new condition of things in Greece is giving rise to much activity in the direction of improving communication. Not only is the cutting of the Isthmus of Corinth in hand, but railways are projected and will no doubt soon be begun between Athens and Larissa, and between Arta and Volo, in Northern Greece, while in the Peloponnesus one line is to run along the coast of the gulf from Corinth to Patras, another, starting from Corinth, will run south to Mycenæ and Argos, and then turning westward through Arcadia, passing Andritzena, Tripolis and Megalopolis, will again turn southward through the old Messenia and end at Kalamata on the Gulf of Koron. This line, besides opening up the peninsula for purposes of commerce, will traverse country of the highest interest to travelers, both from its associations in the past and its great natural beauty. A short line is to connect the little port of Katakolo on the coast of Elis with the thriving town of Pyrgos, which is not more than ten miles from Olympia. If these enterprises are well carried out an immense stride will have been taken by the Greek kingdom on the road to civilization. The history of the four-mile railway which connects Athens with the Piræus is encouraging to the projectors of the new lines. It was constructed originally at an outside cost of £800,000.—*Pall Mall Gazette.*

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Water-works are being discussed at Findlay, O., with probabilities that some definite action will be taken soon by the council.

Under the vigorous supervision of the contractors, Russell & Alexander, the new water-works of Topeka, Kan., are rapidly approaching completion.

Work upon the construction of the new water-works at Las Vegas, New Mexico, is being pushed rapidly forward, a large force of men being employed.

JOLIET, Ill., Dec. 13.—The Joliet common council tonight refused to accept the water-works built by Jesse W. Starr. This throws Starr out of $100,000.—*Chicago Times.*

It will be two weeks before the Arnold print works, North Adams, will have water from the tunnel, owing to the difficulty of obtaining iron pipe. The reservoir at the tunnel will be further excavated next spring, so as to hold 6,000,000 gallons of water.

Mr. John I. Osborn, hydraulic engineer, assisted by D. C. Sanford, C. E., is making surveys and plans for a public water supply of Wallingford, Conn. Mr. Sanford, on the evening of the 10th, read a preliminary report to a borough meeting in the Wallingford Town Hall.

The New Haven, Conn., Water Company are contemplating additional facilities for the public water supply of that city, and Engineers John I. Osborn and D. C. Sanford are now engaged in the necessary surveys. A dam and storage reservoir will be built. The estimated cost of various projects range from $69,000 to $97,000.

The Wilmington (N. C.) water-works were completed and successfully tested last month. The contractors for the works were Messrs. J. A. Cloud & Co., who also constructed the works at Jacksonville, Fla.; the pumping machinery was furnished by Messrs. H. R. Worthington & Co., and the interests of the city were looked after by the City Engineer, Mr. J. K. Brown.

The city of Cleveland, O., has just added to the pumping facilities of its water-works a new Worthington pump of 10,000,000 gallons capacity, has built a new boiler-house and machinery, and put in three new steel marine boilers 10x18 ft. Cost, including 1¼ miles of 30-in. main pipe laid, $250,000. They have laid about 12 miles of distributing pipe during the past year.

We regret to perceive a disposition on the part of some people in Austin to belittle the efforts of our fire department. Yesterday afternoon a gentleman from San Antonio was examining a photograph of the ruins of the burned capitol. "I don't see any firemen in the picture," remarked the stranger. "Well, you see, the firemen haven't got there yet. That's why they are not in the picture," said the artist.—*Texas Siftings.*

A water-works company has been formed to supply Hoboken, Union Hill and Weehawken, N. J., with water. These cities have heretofore received a supply from the Jersey City Water-works, but propose to have an independent organization. It is called the Hackensack Water Co., headquarters 47 Montgomery street, Jersey City. Messrs. Spielman & Brush are the engineers. The contract for reservoir has been let.

The Binghamton water-works, who use the Holly system, are putting in additional pumping facilities, and will, when complete, be able to supply 6,000,000 gallons of water every 24 hours. The steam cylinders, 4 in number, are 27-inch diameter, 33 inch stroke; the pump cylinders are 14⅝-inch diameter, 33-inch stroke, double action. The facilities they now possess give only 2,119,000 gallons per day on an average. The cost of the improvements over all, including new buildings, etc., will be $40,000.

The Indianapolis *Saturday Herald* drops, like Silas Wegg, into this timely bit of verse:

A plumber went forth to plumb
To a kingly palace by the way,
And when his half day's work was done
Presented his bill without delay.
The king brought forth his bags of gold,
His diamonds and his jeweled crown,
The plumber credit gave for them—
And took a mortgage on the throne.

The contract with the gas company for lighting the streets of Fond du Lac, Wis., having expired, and the common council having declined to make any further contract for that purpose, the streets are without light, except such as is afforded by the moon. This state of things will probably last for several months, until arrangements can be made for lighting with electricity, or investigation shall show that the electric light is impracticable. A committee of the common council is now examining the subject of the electric light with a view to its adoption if it is found suitable.

The following resolution was adopted June 18, 1881: *Resolved*, That the Superintendent and Engineer of the Cleveland Water-Works be hereby directed to report to this Board at as early a date as is consistent with his other duties, a plan for supplying lake water to such districts of the city as lie above the plane that can be supplied from the present works, together with suggestions or recommendations of such changes, extension or enlargement of the present system as he may deem necessary to meet the demands for water for domestic, manufacturing and public use in this city in the near future.

A day or two since our esteemed friend, Mr. John C. Kelley, President of the National Meter Company, of this city, came into our office with a radiant smile illuming his features, and when queried as to the cause showed us two requisitions from the Water Board of Boston requesting him to deliver to E. R. Jones, Superintendent Eastern Division Boston Water-Works, 60 ⅝-inch, 5 1-inch, and 4 4-inch Crown water meters. We smiled in return and congratulated him upon the insertion of this opening wedge following so closely upon the wedge he drove when the meter was adopted by the Department of Public Works of this city.

The Youghiogheny Water Works Company at Bradford, Pa., is now in operation, the pipe being laid to the summit, 2½ miles, where the reservoir of 2,000,000 gallons capacity is situated. The pumps and engines, two in number, and of a recent patent, were manufactured by Cope & Maxwell, of Hamilton, Ohio, each having a capacity of 2,000 pounds every 24 hours. The works thus far, including pumps, engines, pipes (20-in.), tankage, building, etc., have already cost the company the sum of $75,000. The works are located at what is called the Slope Mine, where a neat and substantial building, of a hard blue stone, 42 x 30 ft., has been erected, in which the pumps are now in operation. In this building there is a well 30 ft. deep by 12 ft. in diameter, walled up and cemented. From this well there is a tunnel 5x3 ft. leading to the river, a distance of 100 ft. In this tunnel the water-pipe, 20 in. in diameter, is laid, which feeds the well from a natural basin in the river some 20 ft. deep. To prevent the well from being flooded during high water there is a cut-off in the feed-pipe by which the water is regulated. The water here is the best and purest that can be found anywhere—pure Youghiogheny water fresh from the mountains. These works now furnish water for the following coke works of H. C. Frick & Co., viz: The Henry Clay mines, 100 ovens; Frick mines, 106 ovens; Morgan mines, 164 ovens; Foundry mines, 74 ovens; White mines, 148 ovens; Eagle mines, 80 ovens; Summit mines, 142 ovens. Besides the reservoir at the Summit of 2,000,000 gallons capacity, there is already tankage along the line of 1,110,000 gallons capacity.

ELECTRICITY.

The common council of Lafayette, Ind., has accepted a proposition to place a twenty thousand candle-power electric light on the tower of the school building, agreeing to pay therefor the sum of $5,000 for two years.

The Electric Light Company, recently organized in San Antonio, Tex., ordered only a ten-light machine, and they have already applications for fifteen. The lights are to be 2,000 candle-power.

The city of Aurora, Ill., forty miles west of Chicago, affords a striking spectacle of the revolution in lighting cities by the electric tower plan. At night the city is bathed in a flood of lambent light, and her citizens are in a state of delighted enthusiasm over the splendid practical results achieved. The system consists of six electrical towers, made of iron rods and network, each 150 feet high. These are crowned with electric lamps of 2,000 candle-power each, or equal to 125 gas jets. The cost complete for each tower and apparatus is about $1,000. One electric tower lamp, fed by soft coal at $3 per ton, gives a 2,000-candle light at 2¾ cents per hour—a ratio of 2½ to 50 compared to a corresponding use of gas light. The people of Aurora are universally jubilant over the result of the adoption of the new system, and express the most earnest and complete satisfaction with the Brush tower plan in all its bearings and aspects.

The wires that must need to be put underground in cities are those supplying electrical lights. As used at present they have proved extremely dangerous to property and involve a constant risk of life, and there seems to be no way of making them safe except by burying. W. A. Anderson has an exhaustive and valuable paper on this subject in the Fireman's Journal. The current of electricity necessary for a light is so strong that, if a wire is too small or is defective at any point, it becomes heated so as to set fire to any combustible substance near it, or if not properly insulated the current is likely to leave it and take a course where it will do mischief. Again, and this danger is worst of all, if the wires of light and of telephone or telegraph circuits happen to touch each other, a fire may be started wherever there is an instrument on the lines of the latter, so that, with light wires in the street, no building in the vicinity containing electrical instruments of any kind can be safe. Fires have been repeatedly caused in all these ways, and the insurance companies have taken the alarm and are trying to compel the use of large wires very carefully insulated, but it is evident that better security is needed than can be given by any possible precautions of the kind. The insulation might be destroyed by accidents, by the heat of imperfect wires, or imperceptibly by friction, and all these dangers would be indefinitely multiplied by the increase in the number of wires that seems certain to come. Edison's promised invention that was to destroy the gas companies has not appeared, but the electric light has advanced by degrees from its place as a scientific curiosity to use as an advertising device, and thence to adoption as a matter of economy. It has proved cheaper than gas under some circumstances, its use promises to increase with very great rapidity, and a method of burying the dangerous wires cannot be too soon perfected.—*Springfield Republican.*

STREETS, DRAINAGE, ETC.

A few weeks ago a very peculiar land slide occurred in Cleveland, O. Two ravines had been filled up to the

street grade about six years ago. A street had been made across the lower end 66 ft. wide, paved and flagged, with water and gas through it. One Saturday evening the whole body of the new fill and street, comprising about 200,000 yds. of earth, slid down, taking all with it, and completely demolishing everything in its way for about 2,000 ft., until it came to another street, which stopped it. The peculiarity of the slide is that the slope of the fill is only about 2 ft. in 100. The sight is an interesting study for civil engineers, and should be seen to be appreciated.

BRIDGES.

BLISSVILLE BRIDGE.—The Queens County Board of Supervisors had before it this week the action of the Joint Bridge Committee of Kings and Queens counties in dismissing Wm. H. McDonough, as engineer of the Blissville Bridge. Supervisor Van Nostrand, chairman of the Queens County committee, in his report to the full board says: "The committee was greatly disappointed, although not surprised, as we have been compelled for the past year to witness the blundering work of the so-called engineer, Wm. H. McDonough, to find the bridge itself too long to enter the approaches, and the said approaches too high to properly fit the bridge." The action of the Joint Committee in dismissing Mr. McDonough was ratified by a unanimous vote.—*Brooklyn Eagle.*

RAILROADS.

The Troy & Chatham Railroad Company filed articles of incorporation; capital, $1,000,000.

The Chinese Government has decided to lay a railway line, formerly between Shanghai and Woosung, from the coast of Formosa to the sugar districts. The line originally laid by foreigners was bought by the Chinese, torn up by the Mandarins, and the material and rolling stock transported to Formosa, where it has been allowed to remain idle until now.

At a recent meeting of the Chicago City Council Ald. Cullerton, assuring "his newspaper friends" that he was "acting in good faith," and that he was embarking in no blackmailing scheme, offered the following:

Ordered, That the corporation counsel be, and he is hereby, directed, at his earliest convenience, to prepare and send to this council an ordinance requiring all steam railroad companies operating cars within the limits of this city to pay an annual license fee of $15 for each and every freight car and $25 for each passenger car or coach, such license to begin on the 15th day of January, 1882.

Alds. Cullerton and Wickersham thought that the scheme was feasible, and that the railroad companies could be made to pay almost the entire running expenses of the city government; but Ald. Phelps denounced it as bosh. It would drive all railroad companies from the city. Ald. Lawler said the city had not yet received license from all the sources from which it was legal to draw it, and it would be foolish to tax the railroad companies until it had done this. He moved the reference of the order to the law department. It was so ordered.

The Lake Shore & Michigan Southern Railroad Company are erecting a magnificent building on the corner of St. Clair and Seneca streets, Cleveland, O., for their general offices. It is of Philadelphia pressed brick with elaborate stone trimmings, five stories high, 100 feet front on St. Clair street and 130 feet front on Seneca street, surmounted by a clock tower, making the height 115 feet. It is entirely fire-proof, having iron beams and brick arches. The interior will be very handsomely finished. The masonry work is being done under contract by Mr. S. C. Kane, of Cleveland, the carpenter work by Messrs. C. S. Brooks & Company, and the iron work by T. H. Brooks; the architect is Mr. Joseph Ireland.

Advices from Indianapolis indicate that matters are not progressing well with the Toledo, Delphos & Burlington system. It is said that W. J. Sherman, Chief Engineer; J. W. McElvaine, General Passenger and Ticket Agent; F. Sprague, Auditor, and J. H. Weller, Division Superintendent, have tendered their resignations. There is much surprise, and two causes are suggested—the unpopularity of the management and lack of confidence in the narrow-gauge system. The retiring officers return to standard-gauge roads.

Over four hundred miles of the road is in operation, extending into the Southern Ohio coal fields south and Veedersburg west.

The construction of extensions to the Ohio River at Ironton and to St. Louis was pushed with remarkable vigor until recently, when suddenly all worked stopped; hence it is feared that the embarrassment is not confined to the management. The prevailing conclusion is that either the road is suffering financial embarrassment or its backers have lost confidence in the system. There is also a quiet rumor that Vanderbilt is endeavoring to get control of the L. S. & M. S. outlet to St. Louis and for a feeder to the Ohio Railroad, which crosses at several points. If he should obtain control the road would be changed to a standard-gauge. Between Veedersburg and St. Louis the road is mostly graded, bridged, tied and the iron is down at many intermediate points.

The construction of the Milwaukee & Madison line has revealed a number of wonderful and exceedingly interesting facts. About eight miles west of Waukesha the place known as Summit Cut is located, measuring 3,600 ft. in length, and varying in depth from about 25 ft. to about 53 or 54 ft. The Summit Cut proved to be composed of very hard material for about two-thirds its entire length, being filled with bowlders imbedded in hardpan or cemented gravel, requiring steady, continuous blasting for a period of about seven months. The great depth of the cut and the hardness of the material necessarily required considerable time to excavate, and the great heat of the summer, followed by the excessive rains of the fall, retarded the progress of the work very much. The cut contains about 160,000 cubic yards of earth. A large amount of the material has been hauled for about a mile, and the excess wasted. On about three miles of the work, a little beyond Summit Cut, about 300,000 yards of hard-pan has been excavated. The work between Milwaukee and Madison has been exceeding heavy, about 1,600,000 cubic yards of earth having been excavated. Along the line sinkholes were continually discovered, these being all that remain of old lakes, now covered with thick growths of tamarack. Many of these old lakes still have some connection with surrounding bodies of water, and when the earth and vegetable growth was once removed, a pool of water was still there, in which numerous dogfishes were found. One of these old lakes was uncovered near Summit Cut, and this has now been well filled up; still another was found near Douseman's station, forty feet deep and about eight hundred feet in length. Between Douseman and Sullivan station three others have also been filled, their depth varying from twenty to about forty-three feet; their length is about 1,100.

NEW PROJECTS.

The Newark, Ohio, Delaware & Northwestern Railroad Company, with a capital of $2,000,000.

Major Fuller, of the Palmer-Sullivan road, with a large corps of engineers and surveyors, arrived at Victoria, Texas, on the 8th.

The Northern Pacific propose building a line of its own on the northern bank of the Columbia River.

The railroad train in Germany that runs by electro-magnetism as the motive power continues to be a great success, and it will not be long ere the experiment is repeated in this country.

The management of the Indianapolis, Bloomington & Western Railroad has determined to extend the Indianapolis, Decatur & Springfield road (just acquired by lease) from Decatur to St. Louis. The surveys and construction are to be pushed with all possible dispatch.

Eleven hundred thousand dollars of the $1,500,000 capital needed to build the new mill at Lewiston, Me., is subscribed, and the balance is likely to come in soon. The stockholders want Governor Plaisted to call a session of the Legislature this winter so that they can work under a charter.

DALLAS, Dec. 8.—The management of the Chicago, Texas & Mexican Central Railroad will make a determined effort to reach Cleburne by Jan. 1, but the chances of succeeding are now doubtful. They have 800 piles to drive, 125 trestles and cut-outs to build, and twenty-five miles of track to lay and only twenty-three days to do it in.

Messrs. Darragh, Kelly & Hamilton, who were the contractors for the masonry work on the N. Y., C. & St. L. R. R., from Cleveland to Buffalo, have just completed their contract, and have done the largest amount of work in the shortest time on record. It is pronounced by competent judges to be a magnificent work. The stone used was largely from the quarries of the McDermott & Berea Stone Company.

Work will be commenced on a magnificent hotel on Crystal Bay, Lake Minnetonka, which will be one of the finest in the country for its size. It will cost in the neighborhood of $250,000, and will accommodate 2,000 permanent guests. It will be fitted up with every convenience that can be desired by the most exacting demands of the public. The bay at night will be lighted by electricity in the vicinity of the hotel.

The Salina & Northwestern Railroad, the charter of which was filed December 8, is designed as a feeder to the Union Pacific and the Missouri Pacific. Capital, $5,000,000. Route is from Salina, by the way of Lincoln Center, to the west line of the State at a point on the west of Sherman County, Kansas. The directors are, Sidney Dillon and Jay Gould, of New York; L. H. H. Clarke, of Omaha; G. T. Smith, of Kansas City; J. P. Asher, of Lawrence; O. L. Williams and H. P. Dillon, of Topeka.

A road will be built from Ainsworth to Tacoma called the Cascade Branch. The final reports of the engineers upon the several surveys are not yet made and can hardly be completed, owing to the severe season, but before next spring the company will, however, build the branch, and if a definite choice of routes can be made in season, work will be commenced from Ainsworth during the ensuing year. The road will pass through the Yakama Valley, a rich wheat-producing country.

A new railroad company has been formed under the name of the Arizona & Nevada Railroad and Transportation Company. Its object is the construction of a line between Callville, Nev., and Yuma, with extensions by rail or water, as may hereafter be determined, to Port Asabel and Libertad, on the Gulf of California. The company has been incorporated under the laws of Arizona, but has its principal business offices in San Francisco. The capital stock is $20,000,000.

The articles of association of the Tonawanda, Wiscoy & Genesee Valley Railroad Company, filed in Albany, Dec. 10, cover a proposed route from Canaden, Allegheny County, N. Y., passing through Hume, Allegheny, Pike and Eagle to Arcade, Wyoming County, a distance of 26 miles. This is a narrow-gauge line and a link of the chain from Coudersport, Penna., to State Line, Wellsville and Arcade, a distance of 94 miles. The survey will commence immediately and the road will be built early in 1883.

The certificate of incorporation of the Tropical American Telegraph Company, limited, has been filed in the office of the county clerk at Freehold, N. J. The incorporators are Frederick M. Delano, of Detroit, Mich.; James H. Howard, of Boston, and James B. Richards, of New York. The object of the company is the construction and operation of telephone lines and exchanges in the several cities, towns and villages in the West India Islands (excepting those of Cuba), Central America, Panama, Venezula, United States of Colombia, British, Dutch, and French Guiana.

Several Newton (Mass.) capitalists propose to build a railroad beginning at Brookline and running through Newton Center and Highlands parallel with the Woonsocket Division of the New York & New England Railroad, crossing the city to Riverside, near Lower Falls, on the Boston & Albany. The road is meant for a connecting link between the main line of the Boston & Albany at Riverside and its branches at Brookline. It will be operated by the Boston & Albany. The scheme is in the hands of J. F. C. Hyde, of Newton, and the capital of $500,000 is fast being subscribed. The corporation will probably be organized in a few days.

Captain John Cowden's Lake Borgne outlet scheme, by the Barrataria canal, has just received influential backing. Messrs. Whitney and Hutchinson, of the Morgan Line, Superintendent Morse, of the New Orleans Pacific Railroad, and other influential business men have declared in favor of it. The gentlemen named, in company with Captain Thomas Scathers, called upon Mayor Shakespeare, of New Orleans, to secure his official influence in favor of the measure and his signature to a petition to Congress in its behalf. The Mayor refused to sign the petition in his official capacity for the reason that it was a matter for the action of the city council, but he cheerfully promised his personal influence in favor of the proposed ship channel to the Gulf. The gentlemen appeared before the council on Monday last to secure the indorsement of Cowden's plans.

As to the completion of the Northern Pacific road Mr. Villard said: "We are confident of running through trains by the 1st of September, 1883. At the end of 1882 we expect to be up to the furthest point in the Yellowstone Valley to which the main line will be built, and from the West the road will be built to the western base of the Rocky Mountains. This will leave less than 160 miles to be built to complete the road, but this portion of the line includes two tunnels, aggregating about 10,000 feet. This is the most difficult part of the road. I may state that one of the great advantages of the Northern Pacific road over every other Pacific railway is that from the summit of the Rocky Mountains to the Pacific Ocean, a distance of 900 miles, the main line will follow a steady down river grade. In the same distance the Central Pacific has to go over three summits of from 6,000 to 8,000 feet high."

PERILS OF WINTER SURVEYING.—WINNIPEG, Manitoba, Dec. 8.—Considerable excitement was caused today, at the Canadian Pacific railway offices, by the receipt of a rumor that the party surveying the route of the Saskatchewan branch had been caught in a severe blizzard, Douglas, the engineer in charge, being severely frozen and three of his men frozen to death. Gen. Rosser telegraphed to Brandon and Battleford, in the Northwestern territory, but nothing had been heard of the rumor at either place. When last heard of, Nov. 15, the party had crossed the South Saskatchewan, and were running in the direction of Edmonton. Gen. Rosser does not credit the rumor, as Douglas has a lengthened surveying experience and would take every precaution in a storm. The party were well provisioned and additional supplies were sent them recently. The Dominion lands survey party, which left Moose Mountain recently for Winnipeg, were caught in a storm on the plains. Brodie, the surveyor, in charge was severely frozen, and several of the party were also frozen. They suffered dreadful privation, the provisions giving out. When reduced to semi-starvation they killed a pony for food, and finally succeeded in getting back to Moose Mountain, where Brodie had to be left, the others of the party starting for the east via Fort Ellice.

CONTRACTING, MISCELLANEOUS, ETC.

The tunnel at Edwardsville, on the New Albany & St. Louis Air-Line Railroad, is now cut through and will soon be completed, at a cost of $650,000. Cars will be running between New Albany and Milltown, Crawford County by the 1st of January, and possibly a week earlier.

The bids have been opened for the construction of a two-story court-house for Gillespie County, at Fredericksburg, Texas: L. P. Boettler, $24,000; G. W. Konkle, $25,490; Henry Pauly, $28,570; Neumann & Lindahl, $27,500; J. A. Courtney & John Heining, $22,521; T. W. Carrico, $27,243; Mr. Courtney's being by far the lowest bid.

The new dam on Mill River, Springfield, Mass., for the Howard & Bros.' railroad supply manufactory, which was designed by Stockwell Bettes and built by W. C. McClellan, of Chicopee, has been completed and was used for the first time last week. It is a very substantial stone structure of unique form for that part of the country, the face being of a slanting concave surface, which has the advantage of causing a great diminution of jar and sound, and of throwing the water away from the foot of the dam to prevent its wearing away the foundations. The structure is 125 ft long and 20 ft. high and of cut stone, with a granite coping. It has been in process of building since July 6, and has cost the company about $15,000. The company estimate that they have at least 200 horse power, and more can be made available. It is the plan next year to build up new mills along the site, capable of carrying on an extensive business.

ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 24, 1881.

CITY ENGINEER W. W. Brigden, of Erie, Pa., writes us that that city has just finished several squares of stone pavement, Medina center and cobble sides. For several years past Erie has had about $15,000 per year of paving done, and expects next year to lay $35,000 worth, of which $20,000 is to be asphalt. A two-foot brick sewer has just been completed, and two pipe sewers are under way. Public work has increased rapidly in amount in the past five years, and the indications are that, with continued good times, as at present, property owners will petition for much more new work.

THE PROSECUTION OF IMPORTANT UNDERTAKINGS depends often on easy money markets, cheap material and a healthy commercial activity. The present industrial situation affords abundant encouragement for the extraordinary investments in progress. The two most marked features of the iron market just now are the advancing tendency of merchant and construction iron, and the weakening tendency in railway material. Merchant iron has advanced in Eastern markets from 2⅜@ 2⅛@3c., where it now stands, under a very active demand, with production lagging behind still. The vigorous efforts being made to increase the output will very soon be felt. At present orders cannot be placed easily, and most of the business accepted within two weeks has been at prices to be named afterwards. The opinion has been gaining strength that prices of bars and some other kinds of iron will advance during January, and late advices from abroad have strengthened the belief. These apparently conclusive evidences should be taken cautiously, in view of the uncertainty surrounding the foreign markets and the steady expansion of domestic capacity. The condition of the iron trade west of the mountains is quite vigorous. The trade has not yet been compensated for the scarcity of iron occasioned by the long, hot summer and the idleness in the Cincinnati mills caused by a strike. The spread of population West, the increasing acreage, the expansion of boat and barge building for the Western lakes and rivers, with other causes, have combined to create an extraordinary demand for iron and its products in the West, which has enhanced values to the present unusual limits. Furnaces and mills are sold ahead. Fuel is relatively scarce, and consumptive wants are being anticipated as far as can be done without stimulating prices. The present tendency of prices is therefore to a higher level, and manufacturers have recently been insisting on outside quotations in view of the advance. Foreign iron shows no more probability of coming in than two weeks ago. Domestic productive capacity is barely equal to requirements, although it is being increased, and while these causes continue to act, very firm prices may be expected.

The situation is different with railway material. The demand has not abated in the least; manufacturers of steel and iron rails are receiving inquiries constantly for future deliveries, and numerous orders are being placed. Foreign mills are pretty well filled up. Quotations abroad have been advanced within a few days, ocean freights are scarce, and uncertain. In the United States the expansion of capacity has at last begun to affect quotations for distant deliveries, and within a few days prices on large contracts closed have declined sharply. One new rail mill is projected; improvements are in progress in others. The extension of railway facilities to new mines promises to effect a much-needed reduction in raw material. Bessemer pig is advancing because of extraordinary demand; but causes are at work even in that branch of production which will reduce cost. Old rails also have at last begun to weaken, and iron rail mills will be provided with blooms and old rails in a few weeks, at prices which will enable them to utilize their capacity to maintain the supply of rails at maximum limits.

METRICAL MEASUREMENTS.

At a late meeting of the International Institute for the Preservation and Perfecting of Weights and measures, held at Cleveland, Ohio, Nov. 26, addresses were made by the president and others, and letters read from individuals in sympathy with the object of the Institute.

In a report of the Secretary we find the following:

"Already it is conceded by members of the British Parliament that the effective dissemination by this institute of instructive information regarding the evils of the French metric system, through the public press, auxiliary societies, lectures, pamphlets, etc., has created a strong determination for the extinction of even its permissive use throughout Great Britain, and quite recently an act of Parliament has been passed to that effect. It being expedient that more aggressive steps be now taken for the extinguishment of this evil in the United States, another memorial is now being circulated for signatures, praying Congress that hereafter no weights or measures, other than the Anglo-Saxon—as modified and defended by the United Stated statutes—shall be used in any branch of the public service whatever, until otherwise ordered by act of that body.

"Over 1,000 signatures to it have been obtained in the city of Cleveland within a short time. These memorials have been sent by thousands all over the United States, to those representing the different classes of men, with the request that when the signatures were obtained, they would promptly forward the same to their respective members of Congress, for action."

We hope the Secretary, in sending his circulars, included as little as may be of the proceedings of this convention, if we may judge of its character from the four columns of solid matter in the Cleveland *Leader* of the 25th and 26th.

We extract from a letter from Mr. Muir, of Melrose, Scotland, as follows:

"All that about the British Inch in the Great Pyramid is pure moonshine. It cannot be. It is contrary to the fundamental nature of the case. There is no measure in the Great Pyramid which is not a kosmic commensuration. The British Inch is out of truth (as the British people themselves are) with the Kosmos. Else would there be no need that Elias come to restore all things. * * * This is of immense moment, because it was the first step that led to the discovery in the Great Pyramid of the expression of the annual amount of the sun's shift in space, viz.: something more than 170,000,000 miles; I have not the figures before me."

This allusion to the British Nation, as also to Elias' second coming, is very happy, and as an argument decidedly convincing. The determination by this means of the sun's proper motion in space is important if true, which, unfortunately, we are lacking in means to verify. Another strong argument is offered by a member as follows:

"As to the objects in view by the society, I would say that my whole heart is still in sympathy with them, and, I doubt not, ever will be. As each year passes by it adds to the already strong chain of evidences going to show that the Anglo-Saxon race is unlike all other races—it is an overshadowing race, and apparently destined to spread over all the earth, and that this people are the inheritors of the original God-given system of weights and measures, as treasured in that grandest of ancient monuments, the Great Pyramid of Egypt. The links of this chain of evidence reach back far, far into the deep past age, beyond the flood, and it seems to carry us back almost to the very gates of Eden, if not into the garden itself."

But leaving the pleasant walks of Eden with some reluctance, we are repaid by some glimpses of common sense in a letter from an American engineer in Mexico as follows:

"EXTRACT OF A LETTER FROM MR. A. M. WELLINGTON SUPERINTENDENT OF CONSTRUCTION OF MEXICAN NATIONAL RAILWAY.

"Tell Mr. Latimer that I am not yet more in love with the metric system than in Cleveland. The simple truth is, that for railroad surveys, at least, the 100 foot chain, 10 foot poles and contours, and one foot lines on profile paper, are noticeably more convenient than the metric equivalents. Our surveys were begun in the first system, but the government required a change, which—largely by inexcusable shiftlessness in headquarters—has introduced the d——l's own confusion in the system of keeping maps, notes and surveys. We have twenty meter stations, 25 meter and 100 meter; two different horizontal scales for profiles, and three different vertical 2 meter and 3 meter space for contour lines, and the d——l knows what all, so that a profile or map means hardly anything; but much of this is not to be chargeable to the system."

We have had knowledge of the labors of this anti-metric society for some time, but was not aware until lately that such stuff as was gravely read at this meeting had the countenance of the officers of the association, and would recommend that this twaddle about the pyramids of Egypt, or the measures which the Almighty by revelation had intended man to use, be omitted from the printed proceedings of the association, as calculated to weaken their claims to consideration.

We do not notice the labors of this convention with a view to provoke discussion as to the merits or demerits of the metric system—on the contrary, we would deplore any such result, there having been enough already written on the subject—but there is one point upon which we think there is a misapprehension, and that is, that the meter, the unit of the French system, possesses some advantages as a universal standard not offered by any other conceivable measure of length, and that if all the meter measures in the world were destroyed, it could be restored by recourse to the same process by which it was originally determined, and this with more certainty, accuracy and ease than any other standard in existence. If this be not so, it is a very unscientific proceeding for us to change our standard of measure for one which possess none of the claims to universality in its restoration urged by its advocates. When the meter was adopted in France, it claimed to be the *one ten-millionth part of the quadrant of the meridian of the earth's surface.* This was ascertained by measuring ten degrees of a meridian passing through Paris, and from this deducing the remainder. The true figure of the equatorial circumference of the earth not being fully understood then, the inference was allowed to obtain that the same result will follow the measurement of a quadrant of any other meridian. But it is now known that, owing to irregularities in the figure of the earth, not only do such meridians differ in length among themselves, but that the measure of the French meridian was, to a certain extent, at fault, and therefore, the meter to that extent not what it purported to be; and in the enactment establishing the meter as the standard in France, its reproduction, in the event of its loss, is made to depend, not upon any measure of a meridian, but upon reference to the length of a pendulum beating seconds at Paris. Now if Paris was the center of the earth this might be regarded as sufficiently universal in its application to the purpose, did we possess nothing better—but we do.

If a dozen meridians were measured, differing among themselves, yet the polar axis of the earth,

a simpler element of the earth's figure, would be measurably constant, and a unit of measure referred to that line less objectionable on the score of non-universality. Such a unit is the English inch, as now in use, which differs less from the 500,500,000th of the polar axis than does the meter from the $\frac{1}{10000000}$ th of the earth's quadrant.

If the English inch were increased in length by $\frac{1}{1000}$th, a quantity not appreciable to the senses, it would be *exactly* $\frac{1}{100010000}$ of the earth's polar axis.

This subject, showing the effect of taking the English yard of thirty-six inches and the foot of twelve inches, in lieu of the meter, is treated by Sir John Herschel in his usually masterly manner, and we commend the reading of it to such as are disposed to go the Pyramids for the establishment of the English inch as a universal unit of measurement, while its value to the English-speaking nations of the world rests upon characteristics of far greater value than the bare *presumption* of Divine revelation.

VENTILATION.

With respect to ventilation, it is the thing that the natural man abhors. In reference to it, I feel inclined to paraphrase that which has been said about charity, namely, that it is an emotion of the mind in which A never sees B in want, without desiring to relieve him, not with the goods of A, but with the goods of C. Similarly, it may be said that when A feels the atmosphere of a room stuffy, he desires it to be changed, not at the risk of himself, A, catching cold, but at the risk of B, or any person other than A. If a proof of this were wanted, let me refer you to any assembly where there is some big man whose orders are taken—a judge on the bench, or a chairman of a meeting. What is the direction to the attendant when the judge or chairman feels there is a need of ventilation? "I feel the air of this court or room very close; open two of those windows down there;" not "open two of the windows near me." The big man with the natural fear of ventilation, lets somebody else bear the burden, while he himself gets the benefit. It is very rarely indeed that the man "down there" has either the readiness or the courage to protest. The only instance that occurs to me of the kind is that of Sydney Smith, when, as a curate, sitting at a dinner largely attended by the higher orders of the clergy, he said to the waiter, who was about to open a window close by, "Don't give me my death of cold; open one behind a bishop."—*Sir F. J. Bramwell to the Society of Arts.*

We think it was Dr. Franklin who said that "Public health is public wealth," or if he did not, he might well have said so, and nothing is more important toward this end than the knowledge of how the first requisite toward the attainment of the conditions of public health can best be obtained. The first necessity of life is air, and that the poisons constantly being disseminated from the surroundings attendant upon civilized life (if they cannot be dissipated entirely), shall be diluted to the extent of harmlessness; proper ventilation becomes a necessity.

So much has been written on ventilation, and so much has been done avowedly with that intent, but so obviously failing of the result promised, that the subject has come to be regarded as one of which no one has yet grasped the principles, but in its leading features ventilation presents no complexity as applied to single apartments, though a deficiency of knowledge in those who conduct or manage it often renders the most simple and reliable plans of little or no use.

We have read with much interest a book published by Van Nostrand, entitled "New System of Ventilation; a Book for the Household, by Henry A. Gouge," and having ourselves witnessed the successful working of the system proposed, which is neither intricate nor expensive, we can commend the work as worthy of attention, the system being based upon sound principles. Whether the book of some 175 pages is for sale, or is for gratuitous circulation, we are not informed, but recommend it as interesting reading, even to such as do not feel the need of special appliances for securing fresh air.

PERSONAL.

Mr. Silas Seymour, New York State Engineer and Surveyor elect, took the oath of office before the Secretary of State, at Albany, on the 19th.

Dan. T. Casement, of the well-known contracting firm of Casement Bros., died in this city on the 14th inst, aged forty-six.

Assistant Engineer George S. Willets has been ordered to take charge of the department of steam engineering and ship building in the Franklin Institute of the State of Pennsylvania.

Russell Hardin, for a long time agent of the International Improvement Company at San Antonio, has been appointed superintendent of construction on the Texas-Sabine Railway, with headquarters at Trinity.

Mr. G. W. Waite, late Chief Engineer of the Chicago, Texas & Mexican Central, has gone with a corps of engineers to Rosenburg Junction to accept a position on Count Telfener's Texas & Mexican road as locating engineer.

Mr. W. J. Sherman has been appointed Engineer in Charge of Roadway, Bridges and Buildings of the Louisville, New Albany & St. Louis Railway Co., with office at Evansville, Ind. He will have full charge of maintenance of way, bridges and buildings.

J. T. Jones, Civil Engineer, who has had charge of the opening operations of Palestine (Texas) Water-works, assumes charge for the same company of the water-works at Vincennes, Ind. On the 12th he was tendered a complimentary supper by the city officers and merchants of Palestine.

Colonel Newman was at Palestine, Tex., on the 15th, on his way to the City of Mexico, where he goes, taking with him an engineer corps to commence locating from that city to meet the International locating party already on the way down the Rio Grande valley toward the capital of Mexico.

Mr. Graham Smith, C. E., Past President of the Liverpool Engineering Society, and with whom as a writer and correspondent for engineering journals our readers are quite well acquainted, has been appointed Engineer in Chief to the port of Rangoon, India, at a salary of $6,000 per annum. Mr. Smith left England for his new post on the 7th inst.

D. W. Washburn, Chief Engineer of the Gould construction companies, will establish his office at Laredo. A branch office will be built at Fort Worth, from which the building of the Fort Worth & Denver Railway and Missouri Pacific Railway will be directed. From Laredo the extension of the International & Great Northern south to the City of Mexico will be managed.

Wm. P. Shinn & Co. is the name of a firm recently formed for the purpose of transacting a financial agency business at No. 16 Cortlandt street, New York, selling and placing bonds and stocks, negotiating and procuring capital for the building of railways, development of mining and manufacturing properties, and generally promoting transportation and industrial enterprises. Mr. W. C. Andrews is President of the New York Steam Co., and has since 1856 been identified with the railroad, coal and iron interests of the Mahoning Valley, O., as a member of the firms of Andrews, Hitchcock & Co., of Cleveland, O., miners and shippers of coal; Andrews Bros. & Co., of Youngstown, O., manufacturers of pig iron and shippers of coal, and as a projector and builder of railways in that valley. Mr. Andrews was also one of the projectors of and is largely interested in the Imperial Coal Co. and Montour Railroad Co., near Pittsburgh, Penna. Mr. Wm. P. Shinn is President of the New York Manganese Co., and has since 1850 been engaged in the location, construction and operating management of the Pittsburgh, Fort Wayne & Chicago Railway, Ashtabula & Pittsburgh Railway, and the Alleghany Valley Railroad, having been Vice-President of the A. V. R. R. Co., President of A. & P. R'y Co., and having filled several responsible offices in the P., F. W. & C. R'y Co.; he was for five years the engineering expert of the Pennsylvania Railroad Co., charged with examining and reporting upon railroads, with a view to their purchase, lease or control by the P. R. Co. Mr. Shinn was interested in the Edgar Thomson Steel Co. (Limited), and as General Manager had the general supervision of the building of its extensive works near Pittsburgh, and had the business management of the company's affairs during the first four years of its manufacturing operations. He was during 1880 President of the American Institute of Mining Engineers, and is a member of the American Society of Civil Engineers.

VAL DE TRAVERS ASPHALTE.

Asphalte appears to have been used from the earliest period of the history of constructive works, its peculiar adaptability and the comparative ease with which it could be obtained combining to render its use general. It is claimed that the antiquarian researches of savants have shown that it was used as a binding material in the buildings of Babylon, and as corroborative evidence we are pointed to various localities from whence it could have been obtained. In 1721 a work was published by Dr. d'Eyrinis, in which he strongly advocated its use for all purposes for which cement and mortar were applicable.

It was used as a street pavement in Paris in 1838, but soon after, as it came under the control of machinators—in this case financiers—who claimed for it properties making it suitable for every conceivable form of work, in fact a sort of constructive specific, it was held in disrepute. It was not until 1854 that the Rue Bergière was paved with compressed rock of the Val de Travers, and after a continued use of fifteen years portions of this road were removed, when it was found that the asphalte had lost but five per cent. in weight and had been reduced in thickness from two inches to one and three-quarter inches. From this as a beginning the use of asphalte has grown to its present proportions. In Austria there are 65,492 square meters of carriage roads, sidewalks, etc.; in Hungary, 163,235 square meters; in Paris a very large area; in Berlin 112,000 square meters of carriage road; in London 482,000 square yards of Val de Travers, or, as it is better known in this country, Neuchatel asphalte.

Val de Travers asphalte is a carbonate of lime naturally impregnated with from nine to thirteen per cent. of bitumen, and is obtained from the company's mines of the same name in the Canton of Neuchatel, Switzerland. From a paper by E. P. North, C. E., before the American Society of Civil Engineers, on the Construction and Maintenance of Roads, and for which the Norman medal was awarded, we take the following analysis of this asphalte:

September, 1876; 5 samples:					
Bitumen	9.46	9.48	11.98	11.96	10.06
Carbonate of lime	90.54	90.52	88.02	88.04	89.94
	100.00	100.00	100.00	100.00	100.00
Loss at 212°	1.46	1.42	3.04	3.22	1.92

"The loss was moisture and light oils. A small amount of silica was estimated with the lime."

In a series of analyses by M. Durand-Claye, Engineer-in-Chief, Director of the Laboratory *Ponts et*

Chaussées, of various asphaltes, we find the following of Val de Travers:

Water and volatile matters at 100° Centigrade	0.35
Matters soluble in sulphuret of carbon (bitumen)	8.70
Sand	0.60
Sulphur	0.08
Iron combined with sulphur	0.21
Alumina and peroxide of iron	0.30
Lime	49.50
Magnesia	0.10
Carbonic acid and waste	40.16
	100.00

"Sample No. 1 (the above) is an almost pure limestone impregnated with bitumen. It is asphalte in the proper sense of the word."

The asphalte is laid in two forms—compressed powder and mastic. The pure rock as it comes from the mines is crushed in a Blake crusher, and then ground fine by a Carr disintegrator. The foundation upon which the powder is laid consists of one part of best English Portland cement to eight parts of broken stone and sand, laid from five to eight inches thick, according to the locality and the consequent amount of traffic. After the foundation has thoroughly set, the powder, having been heated in revolving cylinders to between 260° and 280° F., is spread by means of rakes to such thickness that when compressed it will be from one and one-half to two and one-half inches thick—depending also on the amount of traffic. The compression is effected by iron rammers, or *pilons*, which are rods of iron having an iron disk covering the lower end, the tool weighing about twenty-two pounds. The work begins with light blows, and ends with vigorous ones, it being finished when the blow produces a resonant sound. After the surface has been thoroughly compacted it is tested with a straight-edge and rubbed with smoothing irons or *lissoirs*, which consist of a curved iron, weighing about thirty-eight pounds, attached to a handle. These tools are heated, as the powder would stick to them if cold. After having been dusted with cement and allowed to cool the traffic is turned on.

The mastic is the pure powder to which has been added a certain percentage of refined bitumen. The bitumen is melted in an iron boiler, and the powder is added and stirred until the two are thoroughly incorporated, when the resulting mixture is run into hexagonal molds, bearing the trade-mark of the company. When required for use the cakes are broken into pieces, weighing about five pounds, and remelted in caldrons with a small quantity of refined bitumen. When melted, dry silicious gravel is added, in proportions varying from thirty to sixty per cent., and the whole is well stirred until the grit is thoroughly incorporated with the mastic. This is now carried to the work in pails and spread with wooden floats and rubbed until the surface is perfectly smooth. This mastic is particularly applicable for sidewalks, light carriage ways and floors of warehouses, etc.

In the remainder of this article we shall consider the questions of durability, original cost and maintenance, sanitary advantages and such other features as may be both interesting and instructive. From a paper by E. B. Ellice-Clark, C. E., associate member Institution Civil Engineers, we find that M. Chabrier made the statement that the effect of wear and tear on asphalte is so trivial that it may almost be said to be imperishable so long as no other cause than friction of wheels occurs to alter its working conditions. Mr. Clark does not accept this statement without challenge, but says that "the wear is unquestionably so light that exaggeration is not necessary, even by partisans." Some of the heaviest traffic streets of London, Eng., have been laid with asphalte, and in a letter from Col. William Haywood, City Engineer, dated September, 1876, we find the following sentence:

"The first specimen of Val de Travers' Compressed Asphalte was laid in the carriageway of Threadneedle street, in May, 1839; it is in good condition now. Towards the end of 1870, Cheapside and the Poultry were laid with the same material; these thoroughfares are subject to an enormous traffic; the pavements are still in good condition."

In Threadneedle street there were laid 485 yards, and in Poultry and Cheapside 7,854 yards. Mr. Clark states that he examined the first mentioned street a few weeks prior to the date of his paper (August, 1879), and found it in good condition, except where places had been cut out for experiments or repairs. He estimated that it had been subjected to a traffic of 200,000 tons* per annum per yard of width.

Further reports upon specimens taken from the streets of London prove that asphalte is compressed without appreciable wear under heavy traffic; a piece from Cheapside, which was first laid two and one-quarter inches thick, had been reduced in bulk five-eighteenths of an inch, and had lost two sevenths in weight. In Grace Church street, when the annual traffic amounted to 603,000 tons per yard in width, the material had lost but an inconsiderable percentage in either bulk or weight. Results in the cities on the continent of Europe are substantially the same, and all tend to prove that when properly laid upon a durable and unyielding foundation asphalte takes high rank as a pavement in respect to durability.

Original cost and maintenance seem to be the main items considered by most city authorities, who completely ignore more important considerations. In Mr. Clark's paper we find the following table, in which the cost is reduced to 100,000 tons per annum per yard of width:

DESCRIPTION.	Original cost per square yard.	Interest on original cost	Sinking fund at 3 per cent. compound interest.	Maintenance per square yard.	Scavenging per square yard.	TOTAL.
	s. d.	d.	d.	s. d.	{ gv'l / 5.0	s. d.
Wood (Liverpool)	15 1.5	7.5	10.1	01		2 2.5
Val de Travers compressed asphalte	18 0	9.7	...	03.6	0.4	1 1.7
Granite	17 9	9.6	0.5	01.3	2.5	1 1.9
Macadam	4 9	2.1	....	36	12.0	4 8.1

No charge is made for the renewal of asphalte in the above table, as the annual sum for maintenance provides the asphalte in perpetuity. This sum for maintenance in London is an annual amount paid by the city to the company, and in consideration of which the company assumes all responsibility in regard to wear, and agrees to keep the roadway in perfect condition. We have no statistics from which we could tabulate the first cost in this country, but from the records we have of the durability of asphalte the cost of maintenance would be inconsiderable.

From a sanitary point of view the advantages to be derived from asphalte are apparent. Streets paved with a smooth, impervious surface, which offers no place for the lodgment of dirt, are of the utmost importance, because of increased cleanliness. The following table shows the result:

MATERIAL.	Superficial yds. for each load of mud.	Traffic in tons per annum per yard in width.
Macadam	344	25,000
Granite	500	50,000
Wood	1,666	25,000
Asphalte	4,000	500,000

General observations place the materials regarding absorption as 1, macadam; 2, wood; 3, granite and 4 asphalte.

Mr. Mauric Bixio, President of the Paris General Cab Company, has compiled the following table in regard to traction of the four-wheeled cab weighing 1,447 pounds, on various kinds of pavements:

Traction on rough pitching	36 lbs
" small sets	32.5 "
" macadam	30.8 to 45 "
Compressed asphalte (Val de Travers)	28 "

Much has been said concerning the slipperiness of asphalte, and without being given an adequate trial it has been severely criticised on this point. A horse will become accustomed to a certain kind of roadway, over which he constantly travels, but suddenly drive him upon a short stretch which is new to him and presents a different surface, upon which he must obtain a foothold, and he will fall more frequently than upon the old. Observations in London and Paris show that a horse will travel further without accident upon asphalte than he will upon granite. In those cities, as we have before shown, there is a sufficient length of asphalte to enable the horse to become accustomed to it and to travel accordingly. For these reasons, judgment should be carefully considered in regard to asphalte in this city, as it is only laid in comparatively small areas and as the difference between cobble-stone and asphalte is so great as to even take the horse by surprise when he suddenly goes from one to the other. Mr. Delano states that "Asphalte is not slippery *per se*, but it becomes so if a coating of greasy mud is allowed to remain upon it. Roadways of asphalte, from the same mines as used in London, are laid in Paris, and the complaint of slipperiness does not arise. This immunity is not the result of a drier atmosphere, as some have supposed, but simply that in the latter city the roadways are regularly swept and washed, whereas in London they are not."

The benefits which would be derived by the residents of private houses if streets were paved with a smooth, noiseless surface are too apparent to need discussion, and have been dwelt upon by the medical profession, who consider the noise produced by travel over rough streets as extremely detrimental to health.

European cities recognize the superiority of asphalte as a pavement, and are continually increasing the area; in the city of London alone, as we learn from a late copy of *The Mail*, the expense of paving last year was as follows: Granite, £10,853; wood, £7,632; and asphalte, £18,647. New York is slowly following these examples, and it is to be hoped that it will, in the near future, replace its stone pavement with one which would be sanctioned by sanitarians and doctors, and which would greatly lessen the work of the steeet cleaning department.

We recently examined the pavement in front of the Hotel Brunswick, which was laid by the Neuchatel Asphalte Company, Astor House, this city, and found it to be as perfect in appearance as when first laid in July, 1879. Although horses are continually standing along the curb in front of the hotel, the surface of the asphalte showed not the slightest sign of mark or wear, nor had the asphalte in this place ever been repaired. The area of this piece is about 1,000 square yards, and although subjected to a large traffic, it has required no repairs except some two or three yards, which became imperfect from the settling of adjacent flagging. Another piece has just been finished, between Eighth and Ninth streets and Clinton and Waverley places, on Fifth avenue, and although at the time of our visit this had been completed but a short time, no impression was made upon it by passing trucks heavily loaded.

* "These weights are approximate and probably considerably under the actual weights. Each vehicle is taken to weigh 1½ tons; probably 50 per cent. might be added to them; but, as there are no means of ascertaining the weights exactly, Colonel Haywood has never given weights in his reports, so that in comparing these figures with those given by other writers, the vehicles must be reduced to the standard of 1½ tons weight each, and the traffic is for twelve hours only each day."

The City of Newcastle, Pa., after a long struggle has at last got water-works in operation. They have been tested and accepted.

THE HUDSON RIVER TUNNEL.

Since our last notice of this undertaking all the various branches of the work have been pushed forward vigorously and successfully. The north heading is now completed about 680 feet from the eastern side of the old working shaft; the south tunnel is finished for a distance of about 525 feet. The average rate of progress for the past thirty days has been three feet every twenty-four hours. This means completed work and covers all the operations. This three feet required excavated material amounting to 40 cubic yards, about three-fourths of which was taken out of the tunnel and deposited some 1,000 feet west of the shaft, where it serves as an excellent filling for the low-lying lots. The remaining silt is thrown back into the finished tunnel, and on it is laid a platform and portable track.

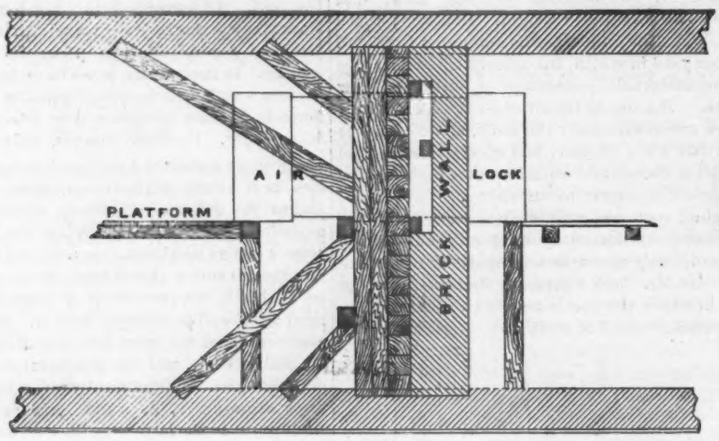
One foot of tunnel requires 120 cubic feet of masonry, one-half of which is concrete and the other half brick; in other words, 1,200 bricks, two and one-half cubic yards of broken stone, six barrels of cement and 10 barrels of sand are used in each tunnel for every foot advanced. At present the silt at the heading is very firm, and could not be better calculated for rapid work by the Plenum process. It has been found, however, that the differences between the maximum and minimum pressures which are most advantageous, are small being only about two pounds per square inch. If the air pressure be increased one pound above what is called "standard," the material becomes too dry, and flakes off in pieces varying in size from the hand to a cement barrel. On the other hand if, from any cause, the pressure be reduced, even one pound below standard, the silt becomes moist and rapidly softens. This standard pressure approximates very closely a column of water of a height equal to the distance from the crown to the surface, but is determined chiefly from actual observation of the condition of material at the point of attack. The working pressure is now about twenty-two pounds per square inch above the atmosphere, at mean low water, and the work is being carried on at a depth of forty-two feet to the crown and sixty-four feet to the bottom of the invert.

Probably the fact that the heading could be or has been advanced at any time without "excavating," any material may be novel and suggest subterranean cavities offering facilities to progress, and though sufficiently novel, it is performed with the greatest difficulty, attended with danger to the men engaged upon it, with the liability of bringing the whole work to a halt. It is a necessary resort in some cases of tunneling very soft material containing sufficient moisture to permit it to flow as freely as quicksand. Suppose the condition of the heading to be as shown in Figure 1, in which *B* is finished brickwork, *D* iron plates, *S* a temporary bulkhead to prevent influx of material; it is desired to put in another ring of plates beginning at *A*. Preparatory work consists in bringing into the heading some quite dry silt that can be made into balls from five to eight inches in diameter. A hole large enough to admit the hand is cut through the bulkhead at *A* and a ball of silt worked into the opening as a kind of plug. A second is forced in which crowds the first backward and upward. A frequent repetition of this process soon forms a skin nearly impervious to air. This skin is worked back with the hand and as it is enlarged, more balls are supplied until the opening—as at *R*—becomes of the required dimensions to admit a plate, when part of this bulkhead is removed and a plate inserted. Of course considerable air escapes, making a very unpleasant noise, threatening a reduction in pressure and a consequent disturbance of the bulkhead, so that the operation requires men of skill, courage and coolness. From three to five hours hard work by ten men are necessary to successfully put in place an iron plate two feet six inches wide by four feet long without "excavating" any material.

It will be remembered that at a distance of between four and five hundred feet from the shaft a bulkhead had been built in each tunnel and two air-locks inserted—one being always open toward the heading. The method of building these bulkheads and the system of bracing are shown in Figures 2 and 3.

The work of connecting the "old working shaft" and "caisson," or, as it has been generally spoken of, as "cutting through the west side of the caisson," has been completed, and, while it presented none of the obstacles or terrors that had long been confidently anticipated, it was sufficiently troublesome to keep up a very lively interest in the minds of not only those engaged in this work, but also of all hands at work in the east heading of the north tunnel, seven hundred feet distant. Although none of the men actually refused to work, several took occasion to remain at home for needed rest, and two or three others, not liking to work at the heading, volunteered to assist in the "cutting through."

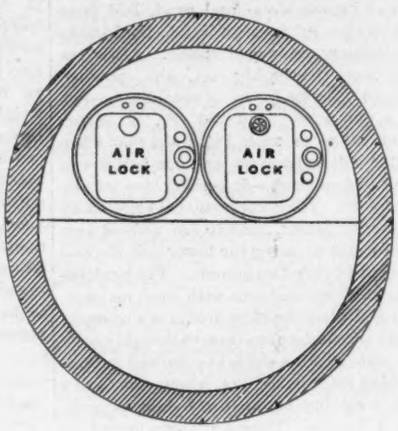
Our readers will recollect that at the time of the accident in 1880 the so-called temporary entrance to the tunnels was being finished and made per-



LONG^L SECTION OF BULKHEAD.

Scale 1/4 in. = 2 ft.

Fig. 2.



TRAN^S SECTION OF BULKHEAD.

Fig. 3.

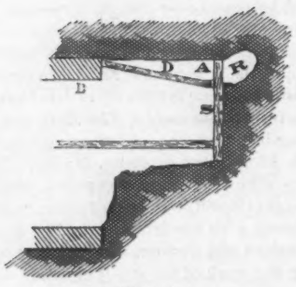


Fig. 1.

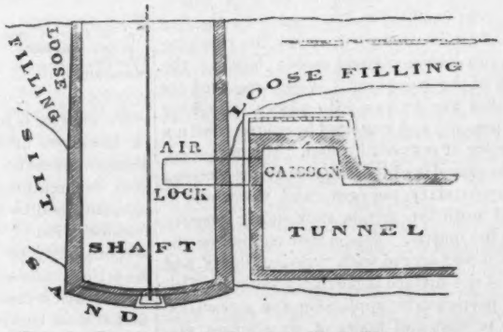


Fig. 4.—Longitudinal Section, New Jersey Side.

manent when it fell in; the caisson which was sunk at that time being about five feet less in width than the shortest distance between tunnel and shaft, and at the sides of the shaft about fifteen feet less, so that the connecting tunnels were wedge-shaped in plan, one side being curved to conform with the contour of the shaft.

After a protracted discussion of various plans for doing the work, one proposed by Mr. S. H. Finch, assistant engineer, was adopted, and its execution has been perfectly successful. This plan was simply to close the doors of the old air lock and shafts leading to the tunnels, admit the compressed air (from the shaft to the bulkheads the pressure had been taken off) and prosecute the work the same as at the heading. It being desirable to complete the connection as soon as possible for convenience in getting materials in to the men, preparations were made by sending down several days' supply of brick, sand, broken stone, etc., after which the old air-lock doors were closed and in three hours the pressure had increased to nine pounds per square inch. The "false" brick work which had been put in to inclose the caisson was taken out, as also the timber on that side of the work. The material was found to be quite dry and very compact, although about fifty per cent. of it was ashes and cinders mixed with silt. Figure 4 shows the different materials at the shaft. No trouble was experienced in placing the roof plates and the work proceeded rapidly, but with extreme caution. After the excavation had been made, the iron shell and a portion of the invert of the south connections put in, and when the silt had been removed in the north connection to within about three feet of the bottom, the water came in very quickly, rising some two and one-half feet in less than five minutes, and compelling a suspension of operations. A two inch blow-out being of no use, the pump in the shaft was connected to the standpipe and a full head of steam turned on, while the air pressure was increased to eleven pounds per square inch, when the water suddenly disappeared and the remaining silt was removed. But before the plates could be connected at the bottom, the water came in again with a rush, but receded with the tide, leaving the bottom dry, when the masonry was laid on the invert without further trouble. The following day the pressure was reduced to eight pounds. Afterward the sides of the shaft were taken out, thus completing the work.

The anticipated difficulty resulted from a knowl-

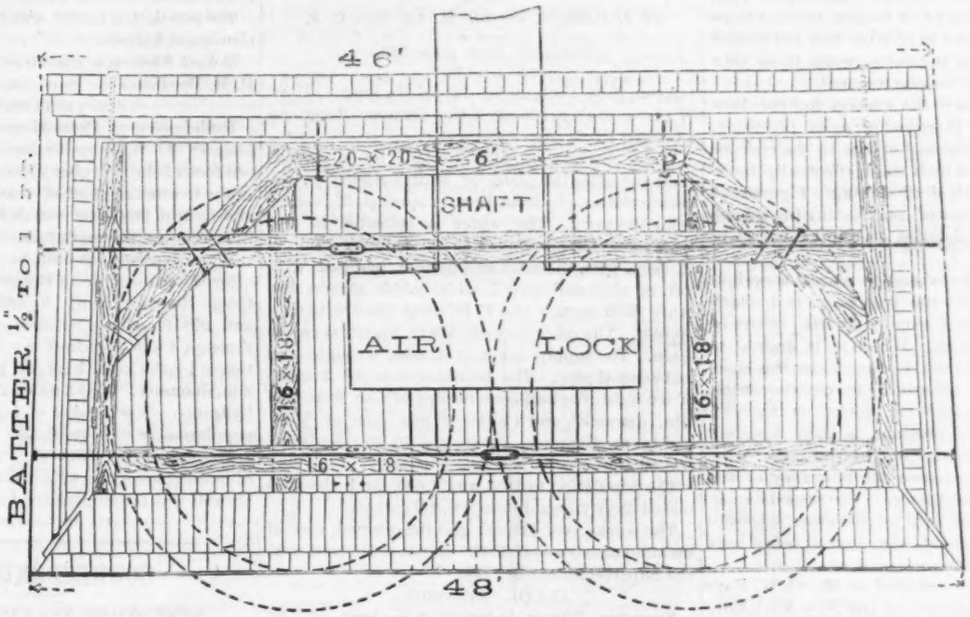


FIG. 5.—LONGITUDINAL SECTION, NEW YORK CAISSON.

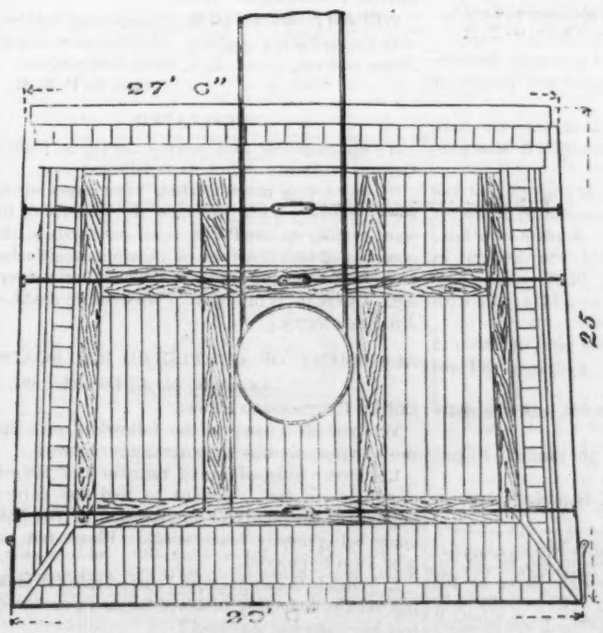


FIG. 6.—TRANSVERSE SECTION, NEW YORK CAISSON.

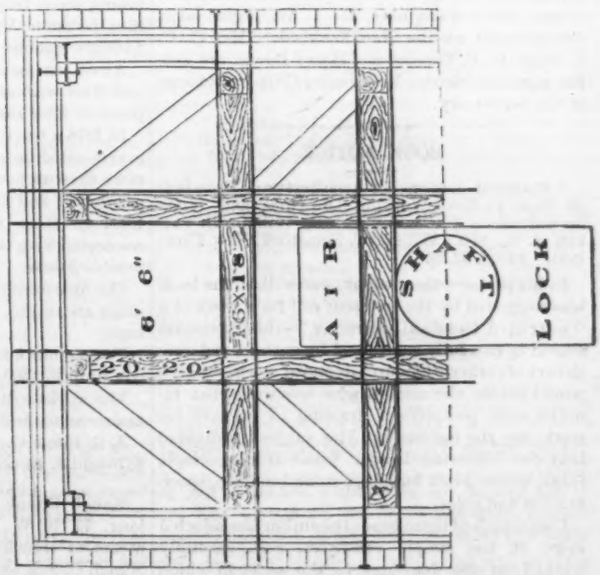


FIG. 7.—HALF PLAN, NEW YORK CAISSON.

edge of the loose filling around the old air-lock and top of the caisson, and the quicksand which was met in the bottom of the shaft and which also gave trouble while putting an invert in the caisson. Both of these (filling and sand) contained abundance of water, and the east heading being the lower it was feared, in the event of water breaking in freely, that the air-locks leading to this heading would become submerged, thus closing the only avenue of escape to some forty men who were engaged in pushing forward toward New York. During the entire work these men were not interrupted for one moment.

The work of sinking the caisson for the New York terminus is progressing most favorably. Much delay was occasioned at first by the remains of old dock-work, which most effectually interfered with the method of sinking. Figures 5, 6 and 7 show the manner of constructing the caisson so clearly that any detailed description would be superfluous.

Upon the top of the caisson is placed a weight sufficient to overcome the buoyancy, and which is increased as fast as demanded by the increased depth and side friction. When it is desired to sink the caisson a trench is dug under the shoe, varying in depth according to circumstances, and all obstacles, such as rocks or timbers, removed. The air pressure is then lowered, when the combined weight of the caisson and its load overcome the buoyancy of the water and it drops into place. No suspenders or guides—such as were used on the other side—are needed, the direction of the descent being kept vertical without them.

We are especially indebted to Mr. C. W. Raymond, assistant engineer on the New York side, for the loan of notes and drawings, and to Mr. C. C. Lovejoy for his courteous services as pilot through the intricacies of the New York caisson.

Gen. W. Sooy Smith and his son, C. S. Smith, are acting chief engineers of the work. Mr. S. H. Finch is first assistant engineer, Mr. C. W. Raymond is also assistant on the New York side. Mr. C. C. Lovejoy, G. P. Thomas and Harry Bowie are acting superintendents; Mr. Charles Clift has charge of the machinery.

BOOK NOTICE.

"Practical Lessons in Architectural Drawing; or, How to Make Working Drawings and Write Specifications for Buildings." By William B. Tuthill, A. M. 8vo. William T. Comstock, New York: 1881. Price, $2.50.

In his preface, the author states that the book was suggested by the frequent call for a work of a "restricted technical character"—this expression should be carefully considered by authors and publishers of other than architectural works—which would enable the student who was somewhat familiar with geometrical drawing to prepare his work for the mechanic. The subject is divided into the following heads: Small frame cottage, frame house, brick building, stone building, specification and color.

Under each of these heads the author has selected more or less simple examples, and carefully worked out the drawings in the order in which they are required in actual building, and, with the aid of concise and plain explanations in the text, has put the work in such shape as to be readily comprehended. These examples have been given as varied a character as possible in a book of this size.

The drawings are all of good size, plainly and neatly executed, and the dimensions and parts are fully explained in figures and letters which can be easily read.

A chapter has been devoted to specifications and a method of writing them.

The last chapter deals with coloring as applied to this class of drawings, and is illustrated by a plate in colors.

The book is well printed, upon a good quality of paper, and substantially bound. It will, undoubtedly, fill a gap which has long existed in kindred works.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 510.)

CLXVI.—AVON.

Avon, New York, in lat. 42° 55′ N., long. 77° 50′ W., is on the right bank of the Genesee River, on a terrace 100 ft. above the water.

Water-works were built in 1857 by a private company after the plans of McRee Swift, C. E., taking the supply from 10 or 12 springs, 2½ miles from the town. The water is collected in two reservoirs, one circular of 45 ft. diameter and 20 ft. deep, with the sides and bottom puddled with 2 ft. of clay and paved with cobble stones; the other 150 ft. square and 17 ft. deep, lined with clay puddle. The reservoirs are 300 ft. higher than the town. The supply main is a 4-in. wrought iron and cement pipe. The distribution is by 3 miles of wrought-iron and cement pipe of 4-in. 3-in. and 2-in. diameter, and 4 miles of gas pipe of ¾-in. and ½-in. diameter. There are 10 fire hydrants and 60 taps.

The population in 1880 was 1,600, and the estimated daily consumption 200,000 gallons.

The works cost $18,000 and the annual cost of maintenance is about $200. Stephen Hosmer was the Superintendent in 1878.

CLXVII.—EVANSTON.

Evanston, Illinois, in lat. 42° 5′ N., long. 87° 40′ W., is on Lake Michigan, 12 miles north of Chicago.

Water-works were built by the town in 1874, after plans of the Holly Manufacturing Company, taking water from the lake and pumping directly into the mains by a Holly engine and pumps of 2,000,000 gallons capacity.

A crib was built extending 125 ft. into the lake and filled with gravel, through which it was proposed to filter the water.

In 1876 a bar formed outside of the crib and the gravel silted up and it was impossible to pump for more than an hour at a time. A plate-iron box, perforated and filled with gravel, was then put in 1,600 ft. from the shore in 21-ft. water, and connected with the pump-well by a 16-in. pipe with flexible joints.

The distribution is by cast-iron pipe, of which 12 miles are in use, with 80 fire hydrants and 400 taps.

The population in 1880 was 4,820, and the daily consumption 300,000 gallons.

The works cost $40,000, and the annual cost of maintenance is $4,500.

J. R. Fitch, C. E., was the Superintendent in 1876 and J. Ebbert in 1878.

CLXVIII.—MAUCH CHUNK.

Mauch Chunk, Pennsylvania, in lat. 40° 55′ N., long. 75° 40′ W., is on the Lehigh River at the mouth of Mauch Chunk Creek. The two towns of Mauch Chunk and East Mauch Chunk are on steep hills on opposite sides of the Lehigh River.

In 1849 water-works were built by a private company, after the plans of E. A. Douglas, taking the supply from a spring 1¼ miles from the centre of the town, and conveying it in a 3-in. wooden pipe for 4,500 ft. to a small reservoir 143 ft. higher than the centre of the town at the Court-house, and 4,590 ft. distant from that point.

In 1855 a reservoir was built to collect some additional springs, and a 6-in. cast-iron pipe was substituted for the wooden one.

In 1861 the company supplied East Mauch Chunk from a small stream a mile from the town, and 80 ft. above it.

Distribution is by cast-iron pipe. The main from the reservoir is of 10-in. diameter, and the distributing pipe from 8-in. to 2-in. About 4 miles are in use, with 28 fire hydrants and 430 taps.

The works cost $25,000, and the annual cost of maintenance is about $750.

The population in 1880 was 5,603. The consumption is not known.

Robert Klotz was President of the company, and R. M. Brodhead the Superintendent.

CLXIX.—HOLLIDAYSBURG.

Hollidaysburg, Pennsylvania, in lat. 40° 30′ N., long. 78° 30′ W., is on the Juniata River, at the western foot of the Allegheny Range. For a number of years it was the point of transfer for passengers and freight from the canals to the inclined plane railroad over the mountain.

Water-works were built in 1867 by the borough after the plans of John Branley, taking the supply from Roaring Run, 3 miles from the town and 279 ft. above it, and conveying the water through a 6-in. Wyckoff wooden pipe. Distribution is by the same kind of pipe, of from 5-in. to 3-in. diameter. Eight miles are in use, with 45 fire hydrants. The number of taps is not given. The population in 1880 was 3,139.

The works cost $73,000. Prior to 1876 the cost of maintenance was $228 annually. In 1878 R. L. Howell was the Superintendent.

(TO BE CONTINUED.)

*Copyright 1881.

CORRESPONDENCE.

BEST STUMP PULLING MACHINE.

BEARMOUTH, Mont., Dec. 1, 1881.

EDITOR ENGINEERING NEWS:

Will you please inform me through your column as to the best stump pulling machines now in use Please address,

L. J. FISK, Contractor,
Care N. P. R. R.

APPRECIATED.

A CIVIL engineer and county surveyor from a California county writes us as follows:

"I enjoy very much getting your paper every week, and only wish you could do something toward *waking up* our Pacific coast surveyors to the necessity of united action in obtaining legislation to shut off *loose* and what I call *criminal* surveying. Our State is full of it. [We wish we could.—ED. ENG. NEWS.]

ALIGNMENT OF COMPLETED RAILROADS.

ANDOVER, N. J., Dec. 17, 1881.

EDITOR ENGINEERING NEWS:

Will you please answer the following questions through the columns of ENGINEERING NEWS?

1. I have a finished line of railroad the records of which are lost. I want to find the correct alignment, the points of intersection of the tangents being mostly inaccessible. Please tell me how I am to proceed.

2. What is the shortest and easiest rule for making out the deflecting distance for any number of feet less than one hundred?

Respectfully, F. MILLER.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

A meeting of the Society took place at their rooms, 127 East Twenty-third street, on Wednesday evening, Dec. 21, Mr. Ashbel Welch in the chair, on which occasion a paper was read by Mr. Hutton, C. E., on the flow of rivers subject to high freshets, and on the effects of the location of bridges on such streams in restricting the flow at such times, and the additional rise of water occasioned thereby, illustrated in the case of the

crossing of the Chemung River, in this State, about ten miles east of Elmira, by the Delaware, Lackawanna & Western Railroad, in proximity to the Erie Railroad, located in the valley of the same river. The case has been in litigation, and the evidence was taken before a commission of the Supreme Court (referred to briefly in ENGINEERING NEWS of Nov. 5).

Mr. Hutton gave a synopsis of the evidence and his views in relation to the proper method of calculation. This was followed by a discussion in which several of the members present took part, and while there was some diversity of opinion as to the precise value to be given to the numerical coefficient in the various formulæ used for flow of water in open channels as applicable to this case, yet there was a decided unanimity in the opinion that not only was there no known formula applicable to all rivers, but that from the nature of the case it was not likely that any formula could be developed for such cases which would preclude the exercise of the judgment of the engineer in the selection of a proper coefficient.

The subject is a fruitful one for discussion, and at some future meeting of the society will be further considered.

ENGINEERS' CLUB OF PHILADELPHIA.

DEC. 3, 1881.

This meeting was the first held in the new and handsome rooms, although they were only partially ready for occupancy.

President Strickland Kneass in the chair. Thirty members and one visitor present.

The resolution of the Board of Directors, authorizing the Secretary to sign the lease for these rooms, was reported and ratified by the club.

Officers were nominated to serve during the year 1882.

The matters of scientific interest presented were as follows:

Mr. John E. Codman exhibited drawings of and described Nicholson's Fire Escape, which consists of a fire-proof brick tower, octagonal externally and cylindrical internally, with central shaft about 18 in. diameter, around which is formed a winding passage, of a U-shaped section, 2 ft. 3 in. in width, with smooth or glazed surface, and inclined at angle of 35°, with retarding curves of less gradient. Fire-proof doors would connect with each floor and roof, and a vestibule with the surface of the ground below. It is intended that those escaping shall assume a sitting posture on entering the spiral and slide to the bottom, and it is claimed to be safer than other escapes for those unaccustomed to ladders, or weakened by fright and excitement.

Mr. Codman also exhibited a working model of Deschamp's Angular Shaft Coupler, by means of which shafting can be offsetted when bearings are displaced or bent to an angle, from 0° to 90°.

Prof. L. M. Haupt exhibited an Interpolating Scale, devised by Prof. W. S. Chaplin, of University of Tokio, Japan, by means of which any intermediate point of elevation between two known points, on a topographical plan, can be readily determined.

He also read a short discussion of Mr. S. C. Gant's scheme of underground railroads in Philadelphia, presented at last meeting. Prof. Haupt, while decidedly favoring rapid transit, and admitting the practicability of the construction proposed, considers Mr. Gant's estimate of cost entirely too low, and, by comparison with the Union Tunnel at Baltimore, he estimates that that portion of the tunnel system which Mr. Gant estimates at $1,733,710 would cost $6,051,500, or about three and one-half times the original estimate, and even this he considers too low for the plan proposed.

Prof. Haupt also read a paper upon railroad cross-ties, touching especially upon the desirability of an iron tie, a model of which he exhibited at the last meeting.

Mr. T. Earl Collins exhibited and described a model of the Cameron Valve Motion.

Mr. Wilfred Lewis exhibited a movable head T square, the head of which is held very firmly in position by means of a cone clutch.

Mr. Howard Murphy opened the proposed discussion upon passenger elevators by reading an account of the means and results of testing wire ropes and methods of attachment to cages, by Herr Baumann, translated in *Abstracts, Inst. C. E.*, vol. lxv., part iii., p. 53.

HOWARD MURPHY, Secretary and Treasurer.

PRECAUTIONS TO OBVIATE THE DANGERS OF ELECTRIC LIGHTING.*

It is scarcely necessary to commend the following to our readers, as it is a subject in which we are all so interested that anything from such a source commands attention:

The committee, to whom was referred the question of "the dangers incident to electric lighting, if any, and the means of overcoming them," respectfully report as follows, viz.:

That from a careful consideration of the evidence submitted they believe that the use of electricity as an illuminant, as now generally employed, is not attended with any dangers, either to person or property, that cannot be obviated by the adoption of the precautions hereinafter set forth.

In order that the reasons which give rise to the necessity for these precautions may be the more thoroughly understood by the general public, for whom they are designed, the committee believe that the following statements of the general principles involved in systems of electric lighting as now practiced, may not be amiss.

There are two systems of electric lighting now in general use, viz., the "incandescence system" and the "arc system."

In the "incandescence system" an electrical current, flowing through a thin wire of platinum, or other difficultly fusible metal, or through a thin filament of carbon, heats it by incandescence to nearly a white heat, by reason of the resistance it offers to the passage of the currents.

In the "arc system" an electrical current flowing from one rod of hard carbon to another, heats the rods sufficiently to cause a stream of carbon vapor to pass between them. This vapor, heated to intense whiteness by the electricity, forms what is known technically as the "voltaic arc."

In the "incadescence system" it is necessary, in order to prevent the rapid destruction of the wire, or carbon filament, to surround it completely by a glass globe or cover from which all the air has been removed. In this system, therefore, external objects cannot come into contact with the source of light.

In the "arc system" it is not necessary to exclude the atmospheric air from contact with the carbons, or electrodes as they are sometimes called. Arc lights are, therefore, burned in the open air. They are generally much brighter than incandescent lights, and are, in practice, usually surrounded by a globe of glass, in order to lessen the intensity of the glare. They can, however, be placed in a globe from which all the air has been removed, since the light produced is not dependent on the burning of the carbon electrodes—that is, on their combustion.

The source of the electricity employed in all systems of lighting is the dynamo-electric machine. This machine produces, more cheaply, a current whose properties are similar to the current obtained from the ordinary voltaic battery.

In the dynamo-electric machine, mechanical energy, derived from a steam engine, water wheel, or any other suitable source, is converted directly into electrical current. The change of mechanical into electrical energy is obtained by the motion, past powerful magnets, of a number of coils of insulated wire wrapped on a core of iron. The core so wrapped is called the armature. The armature moves close to the poles of the magnets already referred to, but does not actually touch them. There is, therefore, no friction in the dynamo-electric machine as in the ordinary electrical machine. The attraction of the magnet poles tends to hold the armature in fixed positions. Mechanical power is required to move it out of such positions, and when so exerted is converted into electrical currents which flow through the coils of wire on the armature.

The current in the armature flows alternately in different directions through the wire wound thereon. It is generally caused to flow constantly in one and the same direction by means of a contrivance called the commutator.

The current so produced flows out of the machine, through a conducting wire, into and through a number of lamps placed at suitable points in the lengths of the wire, and finally through a continuation of the wire back to the machine.

The path of the current from the machine to the lamp, and out of the lamp back again to the machine, is known technically as an "electric circuit."

Any conductor is said to be placed in an electric circuit, or to form part of an electric circuit, when it is so arranged that the current from the machine or battery causing the electricity can flow through it and back again to the place where the current was produced. That is, anything placed in an electric circuit forms part of the conducting path through which the current is circulating.

Dynamo-electric machines are now made to furnish very powerful currents; currents capable of sustaining fifty or more arc lights in one circuit or line. Such currents require care in their management, and judgment in their introduction into buildings or public places for purposes of illumination.

Fortunately, however, the currents produced by dynamo-electric machines have some properties very different from those produced by the ordinary frictional machine. The former possess little or no power of leaping from one conductor to another across an intervening non-conductor, such, for example, as air; the latter can, as is well known, readily so pass, often through several feet or more of dry air.

The currents from dynamo-electric machines, or the currents employed in systems of electric lighting, are not, therefore, at all comparable to strokes of lightning, to which they have often been ignorantly likened. Lightning discharges frequently pass through miles of air, but, even in the largest machines, the carbons employed in arc lamps must first be brought into contact and afterwards separated, before the arc is established and the current passes between them. The current will not, in fact, leap through the air. The momentary contact of the two carbons develops sufficient heat to form a cloud of carbon vapor between them, and this cloud, being an electrical conductor, permits the current to pass.

When, however, the cloud of vapor is once established between the two carbons, it will continue to pass until the carbons are sufficiently divided between the different paths in proportion to their conducting powers.

Suppose, now, that two different portions of an electrical circuit be bridged over by any conducting material. Say, for example, that a wire from a line of telegraph or telephone falls across a line of electrical conducting wires, so as to connect the wire carrying the current from the machine with a part of the wire carrying the current back to the machine. If such electrical conducting wire be uninsulated, a series of cross contacts would thus be formed, and two different paths be opened to the current. Since the conducting power of the short wire, forming the cross circuit, would probably be far greater than that of the portion of the circuit with its included lamp, the greater part of the current thus "cut out" or "short circuited" would pass through the cross wire, either fusing it, or drawing dangerous arcs of flame when the contacts were at times but partial.

This danger may be entirely obviated by insulating the wire. It is therefore preferable to insulate all parts of the wires that lead either from or to the machines producing the current.

As these arcs of flame are very hot, their occurrence should be carefully prevented in all places except between the carbon electrodes in the lamp.

Dangers of this character may be entirely avoided by carefully insulating all the wires which carry the electrical current into or out of the building or space to be lighted.

The comparatively feeble leaping power of the currents developed by dynamo-electric machines, as already referred to, does not, however, necessitate any very high degree of insulation for the wires. Whatever the character of the insulation employed, care should be exercised to insure its being preserved intact on all parts of the wire. The removal of the insulation from but a few points of the wire might cause a dangerous discharge at such points.

When two different paths are open to the current, it will flow through both such paths. If these paths are of different conducting powers, more current will flow through the path which is the better conductor. If one of the paths be twice as good a conductor as the other, twice as much current will flow through it. If it be a hundred times a better conductor, a hundred times more current will flow through it; and so for any other proportion. In other words, the currents will be consumed to cause the distance between them to become too great to be bridged over by the vapor. While, therefore, the current possesses little or no power of so leaping through air, yet it is necessary that no opportunity be afforded it to form such conducting clouds between it and neighboring conductors. A brief

* Report of the committee of the Franklin Institute Dec. 5, 1881, on the precautions to be taken to obviate the dangers that may arise from systems of electric lighting.

mention of some of the ways in which such clouds may be formed will, therefore, be of practical importance.

If two bare metallic wires, conveying powerful electrical currents from different sources, be brought into contact and then gently separated, a cloud of metallic vapor may be formed between them, as in the case of the carbon electrodes.

Or if any portion of a bare wire be brought into contact with one part of a metallic conductor, and a distant part of the same wire again touches this conductor, an arc of flame may be established between the wire and the conductor.

To speak more generally, if any conducting material be placed in, or form a part of the electrical circuit, and from any cause a momentary break be made between it and the rest of the circuit, an arc of flame may result.

If the human body be accidentally placed in the circuit, the partial or entire passage of the current through it may, if the machine be powerful, cause instant death, or, if the machine be of smaller size, produce a painful shock.

But to enable the current so to pass, the body must be placed in the circuit of the machine; that is, the current must be able to enter the body at one point and to pass out and back to the circuit from another point, or, in other words, a break must be made in the wire, and the body inserted in this break.

Here again the difference between the current from dynamo-electric machines and from the common frictional machine, is to be carefully noted. Merely touching any part of a charged conductor of a frictional electrical machine will completely discharge it, the person conducting the discharge through his body to the ground. A person touching any part of a bare conducting wire, while it is conveying a powerful electrical current, such as is used in systems of lighting, would not convey the discharge through his body to the ground, because he would not be placed in the circuit. He has simply provided a place for the current to enter, but none for it to flow through him and back to the machine whence it originated.

Should, however, one portion of the wire touch the ground in any place, especially where it is wet, then his feet might be connected through the damp ground with another part of the circuit, and two paths be opened to the current, with the chances of a dangerous portion thereof passing through his body.

To guard against dangers of this character it is necessary to thoroughly insulate the wire in all places where it is liable to be touched. It is far preferable to establish a continuous metallic line of conductors both to and from the machine, rather than ground the wires, and so necessitate the current to pass through the earth in order to flow back to the machine.

During the burning of lamps of the arc type fragments of highly heated carbon sometimes become splintered from the electrodes and fall below. To avoid danger from this source a cup should be placed below the electrodes to receive any fragments that may fall.

It would follow, from the principles thus briefly enunciated, that there may arise two kinds of dangers from the employment of powerful electrical currents for the purposes of artificial illumination, viz.: Dangers to property from fire; and dangers to life. With the exception of that due to falling fragments all these dangers may be readily and completely avoided by properly and thoroughly insulating the wires that carry the current to and from the machine, while that due to falling fragments may be easily avoided by the means above pointed out.

In order, however, to particularize these different kinds of dangers, and to point out more especially the proper remedy for the avoidance thereof, the committee recommend that the following precautions be taken in all cases where electric lighting is employed, viz.:

1st. That the conducting wires leading into and out of the building be suitably insulated throughout their entire extent, both to and from the machine producing the current.

2d. That an inspection be made at suitable intervals to determine whether or not the insulation has been preserved intact.

The insulation may become impaired by the following causes, viz.:

By the wires being cut by the staples or hooks used in securing the conducting wires in position.

By the wires being placed in positions subject to abrasion, either by chafing with another wire or from any other cause.

By the wires turning sharp bends, or by being sharply bent by any cause whatever.

3d. That conductors formed of numerous short pieces of wire be avoided as far as possible, and that where their use is necessary the joined ends be made as secure as possible by wrapping, so as to prevent short arcs being formed at imperfect junctions, should the joined ends be partially separated from each other.

4th. That the wires be not grounded; that is, that no attempt be made to cause the current to pass back to the machine through the earth, but that a continuous line of wire be provided, through which the current shall so return.

In order that this precaution may be effective, the wires should not be carried near metallic bodies like lines of shafting, nor gas nor water pipes, because an accidental contact of the conductor with any of these would effectually ground that part of the wire. Where it is necessary that the wire cross such metallic bodies, it is advisable that the insulation be made better than usual at such junctions.

5th. That the ready occurrence of cross contacts or short circuits be avoided, as follows, viz.:

That the conducting wires from different machines, or from different parts of the same machine, be kept as far apart as convenient, and never, except when necessary, be brought nearer together than the distance between the two binding-posts on any electric lamp used in the circuit.

That therefore the wire leading from the machine into the room to be lighted should leave the room as far as convenient from the place it enters.

That the wires be securely fixed in position and be not allowed to sag or bend in wide curves, except where it is necessary to permit the raising or lowering of the lamp.

That judgment be exercised in selecting the portions of the building in which to run the wires. To secure as far as possible the absence of moisture, ceilings are to be preferred to walls or floors, the latter being highly objectionable, unless the wires are placed under the flooring. As before stated, the location selected should be removed as far as possible from metallic conductors. Select the places least liable to be rendered partially conducting by moisture from any source, in which to run the wires.

6th. That the conducting wires be of sufficient size to carry the most powerful current employed without dangerous heating.

7th. To avoid the danger to life from the accidental discharge of the current through the body, the conducting wires should in all cases convenient be placed out of reach, either by choice of location or the use of heavy and guarded insulation.

8th. That where lamps of the arc type are used, they be covered with a globe of glass, and that the lower end of such globes be furnished with a cup or pan for retaining any heated fragments.

The committee believe that if these precautions be taken, electric lighting can be thoroughly safe and reliable, and that all dangers attending its use can be entirely obviated.

R. E. Rogers, M.D., Chairman.
Charles M. Cresson, M.D.
David Brooks.
E. Alex. Scott.
Edwin J. Houston.
Isaac Norris, M.D., Secretary.

PRACTICAL SCIENCE IN ENGLAND AND ABROAD.

WHAT AN ENGLISHMAN SAYS OF US.

The industrial energy of the United States affords an example which may be advantageously followed in Europe. It is a matter of some wonder to those of us who can remember the railway system in its cradle, and who are personally aware of the immense start which, five-and-twenty years ago, the forges, the factories, and the railways of England had and held over those of Continental Europe, to see how the spirit of enterprise has spread its wings from our shores. It is to Berlin that one great electrician goes to carry first into practical effect his electric railway. It is from the Alps that the first practical experience, so precious to a mining people like ourselves, in mechanical rock-cutting, and in the application of compressed air to the purposes of mining, is to be derived. And now, in that last new development of the doctrine of the convertibility of the physical forces—lighting by dynamic energy—we find ourselves at a distance behind the United States such as must be measured rather in fractions of a century than in portions of a year.

A glance at the map of the United States, with its straight lines of demarcation, so different from these afforded by either the political or the physical geography of the older world, may serve to impress the imagination with a sense of the rapidity with which scientific invention is carried into practical use in America. From Albany to Great Salt Lake is a distance of 38° of longitude. From New York to New Orleans is a distance of 12° of latitude; Akron (in Ohio), Wabash (in Indiana), Denver (in Colorado), lie wider apart than do Paris, Brussels and Berlin. From each of these distant points, in one single, and, so to speak, casual, letter from an American interested in the progress of electricity, comes the same story. We regard with a mixture of pride and wonder the few experimental steps which, chiefly at the risk of French, and partly of English speculators, have been taken toward lighting parts of London and some other towns by electricity. Neither in England nor on the Continent have there yet been established general lighting stations, to supply electric light after the fashion of gas-works. In the United States, we are told, "no considerable city is without such an institution." At Salt Lake City an arc-light company has for some months supplied electric light to miscellaneous customers. In Denver, Col., a city of 35,000 inhabitants, above 200 arc-lights are supplied to shops, hotels, etc., by a company; the light in each case being furnished at from 20 per cent to 30 per cent below the price of gas, as well as being much greater in quantity. The Salt Lake company is said to have been the first in the world to supply electric light in direct competition with gas. The returns to the proprietors are lucrative in each case.

The subject is attacked in America precisely as, thirty or forty years ago, the manufacture of gas was introduced into our smaller towns. A local company is formed, which, of course, has the advantage of the experience attained up to the latest hour. A concession from the patentees of the system chosen is arranged for. Ground is bought, buildings are erected, and engines, boilers, dynamo-machines, and the whole light-producing apparatus are purchased and erected. Powerful engines are employed, with fly-wheels weighing from eight to ten tons, in order to have steadiness and uniformity of motion, the absence of which is evinced by that flitting, fire-like pulsation of light with which we have become familiar on the banks of the Thames. We have not heard of the application of water-power to the service, but of its adaptability near some of the great rivers of America there can be no doubt. Wires are conducted either under or over the streets, to be tapped where required, in the same manner as gas-mains. Automatic contrivances, for the purpose of turning light on and off at pleasure, are supplied with the lamps, which are visited and kept in order by the servants of the company. The result appears to be the advance of electric lighting all along the line.

The use of masts or towers of the height of 200 feet for the lighting of squares and streets is becoming general. The city of Denver is lighted from lofty towers, and for the price formerly paid for gas four times the area is now lighted by electricity. In the city of Albany 300 electric lights, placed on alternate blocks, have replaced some 2,000 gas and oil lamps. Akron, in Ohio, is lighted from towers; and Wabash, Ohio, by four lights on the steeple of the court-house. In New York there are competing companies, one of which is now supplying 1,000 lights to shops, and is providing for 4,000 more. Most original of all is the application of this source of illumination at New Orleans. In the fever-haunted delta of the Mississippi the comparative coolness of the night is now selected for running the races of the Jockey Club by the light of electricity.

The tariff of the American light companies charges a fixed annual sum for electro-motive power, according to the number of hours for which it is supplied. The companies provide and maintain the lamps; the consumers supply their own carbons. The average price is about £30 per annum for a 2,000-candle light, which is equal to 125 gas lights of 16 candles each. A shop requiring twenty gas-burners would be better lighted by an arc-light of the strength of 100 gas jets. In giving this—the electric light companies' statement—it must, however, be remembered that for many purposes number and nearness of lights will be more important than actual quantity of light radiated from a single point. As to this, however, we can only oppose scientific scepticism to actual practice. The Americans seem to have found out, in spite of the inconvenience of single points of illumination, that they are on the right track.

The above article from the *Builder* closes with

the suggestion that a commission be sent to this country to examine and report upon the subject of the American electric-lighted cities, which would be regarded as a professional paper of the first importance.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Decorah, Iowa, has completed new water-works.

Water was turned on in Dedham, Mass., last week, the new water-works being in readiness to supply the people.

The American Water-Works Association meet in Columbus, O., on the second Thursday of March, 1882; J. H. Decker, Secretary, Hannibal, Mo.

The Lee, Mass., Water Company has built a dam above the one from which the village water supply is drawn, as a storage reservoir for next summer, and it will hold 12,000,000 gallons.

The water-works at Abilene, Kansas, are progressing as rapidly as can be expected when the delay of material by the railways is the chief cause. If no further delays are experienced the contractors expect to have the works finished by Jan. 15.

The superintendent of lamps, Boston, has been instructed by the City Council to place as many electric lights in the principal thoroughfares as he shall deem proper, provided the expense shall not exceed 65 cents per lamp per night.

J. A. Richardson, who has proposed to build water-works for Fort Worth, Texas, has increased his estimate to $60,000. It is now thought that the committee appointed by the council to consider his proposition will report adversely.

Col. John H. Bergen has begun a suit on behalf of the devisees of Susan Catin (the family of the late General P. S. Crooke) against the Flatbush (Long Island) Water works Company, to compel it to take off pipes laid by it in Clarkson avenue, in Flatbush, to enjoin it from using the pipes and for $5,000 damages. The ground on which the suit is begun is that the company has never paid a dollar for the use of the land, or got permission from the owners to use it, and that the pipes are an additional burden and compel the owners to pay a sewer assessment.

The Fond du Lac, Wis., Common Council Dec. 15 resolved to adopt the electric light, and appointed a committee to perfect the arrangements for lighting the city from four towers. The attorney for the gas company was present and addressed the council, giving notice that the company claimed a vested right to light the city, and would seek to enforce its rights. A remonstrance against making the experiment of the electric light, signed by some of the heaviest taxpayers in the city, was also presented to the council. Litigation will undoubtedly arise from the proceedings.

JOLIET, Ill., Dec. 17.—The water-works question is at last practically settled. Jesse W. Starr, Jr., builder of water-works, came here from Louisville, Ky., where he had just put in a system, and closed a contract with the Joliet council for a similar system. It has been finished for the past two months, and, in the meantime, the city has divided into factions for and against accepting the works. The company was to throw water from five hydrants at one time one hundred feet high. They have made two tests and failed, and the council, at its meeting, refused to accept the works. The following resolutions were passed at the council meeting.

Resolved, That forasmuch as the said Jesse W. Starr, Jr., has failed and neglected and refused to construct the said water-works as he had agreed to in the said contract and the supplemental contracts, in the particulars designated in the preamble, and in other particulars not therein nor herein particularly described and set forth and set out, the said city of Joliet does hereby refuse to accept the said water-works, or any part thereof, and be it further

Resolved, That all rights and franchises granted to the said Jesse W. Starr, Jr., his successors or assigns, be and the same are hereby revoked, determined and forfeited; and be it further

Resolved, That the said contract by and between the said Jesse W. Starr, Jr., and the said city of Joliet, and all supplemental contracts referred to in the preamble or resolution be and the same are hereby declared determined, forfeited and amended.—*Chicago Times.*

Mr. Nelson G. Green, of New York City, in a report on the Springfield, Mass., Water Supply, remarks that water once contaminated or rendered favorable to the growth of lower organisms can never again be purified and will continue to contain the deadliest of poisons. Stagnant water like that in the Ludlow reservoir last summer is found to be the most liable to foster dangerous germs, which become active parasites when received into the human system. Stagnant pond water especially abounds in hydatids, so minute that hundreds may exist in a glass of the liquid unobserved by the naked eye. Any one of them on gaining access to the stomach endangers and always shortens human life. Embryos of as many as three specimens of tape-worm have been found in no worse water than the Ludlow, and of a class which are particularly anxious to work their way to the brain, many deaths being annually attributed to them. It has been said that the Ludlow water is purified by the winter weather, but this theory is pronounced false. The water is even considered worse, as the gases which can escape in the summer from the entire surface are sealed up in the winter by the ice and are absorbed to a much greater extent by the water. It is said that at the Ludlow reservoir a bad odor is very preceptible on breaking a hole in the ice. In the light of Mr. Green's investigations, also, our water commissioners appear singularly inconsistent in their expressed opinion that Ludlow water is better than that from the dug wells of the city. This, Mr. Green says, proves nothing, since the average dug well, wedged in among out-houses and stables and in a porous soil, is little better than a cesspool.—*Republican.*

An incident in the history of a New York family has served to explain a matter which many persons have found interesting, but incomprehensible. General Sickles, lately Minister of the United States to Spain, returned not long ago from a four months' trip to Europe, and although his house had been closed during the whole period, he found a bill awaiting him from the gas company for four thousand feet of gas which had been consumed in his absence. Suspecting, very naturally, that some mistake had been made, he refused to pay the bill, and when the gas company sent men to enforce its demands by taking out the meter, he was obliged to obtain an injunction from a court to restrain them. The solution of the mystery is given by a correspondent of the Indianapolis *News*, who suggests that as all gas-meters are constructed to register only a flow of gas in one direction, without noting a back flow, if such should occur, anything which occasioned a variation of pressure in the mains would alternately force gas through the meter into the house pipes, and then, when the pressure was relieved, would allow it to return again to the mains, moving the index of the meter forward at each successive impulse, without any corresponding consumption at the burners, and without any return of the index upon the retreat of the gas to the street pipes. During the manufacture of the gas the pressure in the pipes is for some reason varied, while at night the closing of the theatres or other places which consume large quantities of gas is indicated at a considerable distance in every direction by a sudden increase of pressure and flaring of the house jets which still remain lighted. From all these causes it is probable that house meters usually register a larger quantity of gas than actually passes through them, and the remedy suggested by the correspondent of the *News*, that the gas should be shut off at its entrance into the building, beyond the meter, whenever it is to be for some time out of use, is worthy of being remembered. It has been a standing imputation on the female housekeeper that she never could be made to understand, that so much gas had been consumed the previous month. She is sure there must be some mistake in reading the meter, and the explanation that the next month would rectify it is always taken with misgivings of its truth. Will some one learned in gas matters inform us whether the ordinary meter can register this back flow in the manner suggested by the "*News* ?"

CORRECTION.—Office of the Warren Foundry and Machine Co., Manufacturers of Cast-Iron Gas and Water Pipe, 153 Broadway, New York, Dec. 12, 1881.—*Editor Engineering News:* Will you please inform me where or from whom you obtained the item in your last issue stating that Hornellsville, N. Y., has contracted with us, etc., etc. In your next issue, under head of "Gas and Water," I request that you deny the statement in toto, also add that the Warren Foundry and Machine Company *never* take contracts of that kind.

Yours truly, WM. RUNKLE.

The item was published verbatim as sent us by our traveling agent, who quoted Mr. J. W. Near, President of the Hornellsville city government and a member of the law firm of Near & Platt. Before acceding to Mr. Runkle's request, we wrote Mr. Near for the facts in the case, and he replied on the 17th that he stated to Mr. Tuckerman "that an application had been made to the authorities of this place (Hornellsville) by J. M Low, William Runkle, of New York City, and a number of citizens of this place for permission to organize a water-works company and to lay mains and pipes in the streets, etc., for the purpose of supplying this place with water; that the application had been granted substantially on the terms contained in your paper of the 10th inst. I said to him that no contract beyond the granting of this application had been made. No company has yet been formed; engineers are *now* making a survey and estimate of the cost. When this is ascertained, I am informed a company will be organized for the purpose of said application. I said to Mr. T. that I understood that Mr. Runkle, of New York, was the responsible man in the enterprise." Our agent has made a mistake in associating the Warren Foundry & Machine Co. with the matter, which the above statement of Mr. Runkle will render impossible in the future. We will endeavor to keep our readers posted on the progress of water-works construction in Hornellsville, and wherever else we get even the faintest hint of. That is a part of our business, and a very important part, too.—ED. ENG. NEWS.]

ELECTRICITY.

The Brush Electric Light Company, of Cleveland, are erecting three immense iron masts for lighting the city by their light. One is located in the center of the public square and will be 250 ft. high, 36 in. in diameter at the foot, tapering to 8 in. at the top, and will probably have six lights of 6,000 candle power; the other two will be located in relation to the first at equidistant points, so as to inclose a triangular space. The object of this is to illustrate the combined effect of a group of lights over a thickly built up part of the city. If this scheme is feasible they propose to illuminate the whole city in this manner.

STREETS, DRAINAGE, ETC.

The City Engineer of Pittsburgh, Pa., has submitted plans for a system wherein the main sewers will follow Negley's and Two-Mile Run, the first to drain 2,548 acres and the latter 1,800 acres.

BRIDGES.

The contract for an iron bridge over Cold River, in Acworth, N. H., has been awarded to the Corrugated Metal Co., of East Berlin, Conn.

The Clarke Bridge Company, of Baltimore, have work on hand at present as follows: A bridge, 1,050 ft. long, in six fixed spans and one draw-span, across the Savannah River, for the C. & S. R. R.; four 145 ft. spans for the E. T., V. & G. R. R.; two 125 ft. spans for the R. & A. R. R., in Richmond; one 150 ft. span for the W. & W. R. R.; two spans for the A. & N. W. R. R., one span for the C. & O. R. R., in West Virginia, and six spans for W. Md. Also about two miles of heavy trestle and over fifty Howe truss bridges for the New River R. R.

One of the largest bridges in the country is now in process of construction for the New York, Ontario & Western Railroad. It will be 1,200 feet long and 150 feet high. The bridge will be built of iron and will be about 280 feet longer than the great suspension bridge at Niagara and about 25 feet higher than High Bridge over the Harlem River, though 200 feet shorter. It will be a few feet higher than the New York and Brooklyn bridge and also 232 feet longer than the famous new London bridge over the Thames. As yet only one abutment is completed; the other requires 15 feet more of masonry, and the piers are but just begun. The work will continue through the winter.

RAILROADS.

The canals of New York have profited that State $50,000,000 in net earnings.

A black walnut grove that was planted by a Wisconsin farmer about twenty years ago on some waste land was recently sold for $27,000. The trees are now from sixteen to twenty inches through.

The stocks of the Denver & Rio Grande and of the Mexican National Railway and Construction companies had a serious set back last week and occasioned a considerable ripple of excitement in financial circles.

Winterset *Madisonian*, Dec. 14: A large number of ties for the Narrow Gauge are being got out along Clanton Creek. Ties are being delivered at St. Charles at 40 cents per tie; 2½ cents per tie are paid for hauling them. There are 10,000 ties piled up at St. Charles.

The *Railroad Gazette* reports for last week a total of 370 miles of new railroad, making 7,353 miles this year, against 5,624 miles reported at the corresponding time in 1880, 3,445 miles in 1879, 2,207 miles in 1878, 1,877 miles in 1877, 2 177 miles in 1876, 1,237 miles in 1875, 1,767 miles in 1874, 3,507 miles in 1873, and 6,885 miles in 1872.

The N. Y. Central R. R. freight business has grown from 3,190,840 tons in 1869 to 11,591,379 tons in 1881; at the same time its charges have decreased from 2.38 cents 6per ton per mile moved to .74 cents per mile; there are 15,000 employés; there are 23,000 freight cars, 00 passenger cars and 638 engines; on some parts of theroad 60 trains pass each way daily over its four steel tracks.

About twenty leading manufacturers of Illinois adopted resolutions on the 20th, at Chicago, on the action of the State Railroad Commissioners in fixing uniform rail rates, requiring railroad companies to charge large patrons exactly the same price per car as small ones. They declare that this action will drive from the State $20,000,000 of business, and that they will combine against this unjust discrimination if necessary by taking political action.

LAREDO, Dec. 15.—The track-layers of the Missouri, Kansas & Texas extension completed the laying of the line to the limits of this city to-day. This gives an unbroken direct line of railway from the Mississippi at St. Louis to the Rio Grande at Laredo, making a through line of about 1,300 miles in length. The Southwestern system undertaken by Mr. Gould a little more than a year ago has now been completed from the Mississippi at St. Louis to three points—New Orleans near the Gulf; El Paso, on the frontier of New Mexico, and Laredo, about half way between these two.

El Paso, Texas, looks like a Mexican town, but pretty well Americanized. Paso del Norte, immediately opposite, on the south bank of the Rio Grande, is thoroughly Mexican. The town takes its name ("the pass on the north") from the fact that the river can

forded here, but no other place within a hundred miles, and also on account of being a good wagon pass through the mountains. Some Yankees have just completed a bridge and are making piles of money collecting tolls from teams and footmen. It seems strange that the Mexicans would go all these years without a bridge when one could be built for $1,000.

Many curious things attract the notice of "a man from the States." The air is clear, and cigars get so dry as to be useless. The finest Havana cigars cost about the same as common ones in Topeka; beer, in very small glasses, two for a quarter. The Mexicans get their wood by digging, and the best water is on the highest lands. When they go to cut hay they take a hoe and dig it up. Ox-carts have heavy wheels made of three pieces, one piece about 4 ft. long and 2 wide, with ends rounded, and two short pieces of "fellows" fastened on to complete the circle.—*Topeka Capital.*

Many fear that we are building railways too fast. Yet a careful statistician, Mr. Edward Atkinson, is not frightened at the fact that we have already nearly 100,000 miles, but believes that in the next sixteen years we will have added 100,000 miles more. This would be an average of a little over 6,000 miles of new road per year, while we are building this year nearer 10,000 miles. Averaging the cost per mile at $35,000, Mr. Atkinson estimates that each 100 miles requires the service of 5,600 men for a year, and that to build 100,000 miles in sixteen years will require the continuous employment of 350,000 men.

Mexico is now reached by an American railway line. The construction forces of the system are now rapidly concentrating at this point to commence the great work of pushing on 700 miles further to the City of Mexico. The engineers who have had this part of the work in charge have completed their preliminary report. It is very favorable. The line will run through a rich mining and agricultural country. Extensive deposits of coal have been found on the line of the road, and such arrangements are making that a standard-gauge railway line to be operated by the Missouri Pacific Company from St. Louis through to the City of Mexico, 2,000 miles in length, may be expected to be completed and in operation in eighteen months from this time.

The last rail of the Decatur, Marquette & Northern Railroad, running between Marquette, Mich., and the Straits of Mackinac, was laid on the 9th inst. The line runs through an unbroken wilderness. When Superintendent and Chief Engineer Thomas M'Keown and C. S. Musson, resident engineer of the road, had occasion to inspect the line located by the engineers, one year ago, they were hauled over the right of way by a dog team, that being the only mode of transportation available in the then condition of the route. The preliminary survey of the road was commenced in the fall of 1879, and the work of construction was begun the next winter. For the purposes of construction it was divided into western and eastern divisions, and work was commenced simultaneously on both—at the Marquette end on the western division, and at St. Ignace on the eastern division, McDermid & Hendric being the contractors on the former, and John D. McDonald on the latter. Since that time work has been most vigorously pushed through all seasons of the year, and under all conditions of weather, until now, the task is finished, and the iron horse traverses without obstruction the wilderness of forest, thicket and swamp, through which one year ago a light sleigh drawn by dogs was the only means of conveyance. The length of the line is 152 miles, 60 of which lies through swamps. In one place, for a stretch of ten miles, the road is built through a marsh that presented an almost insuperable obstacle to its progress last fall, in consequence of the heavy rains. Great difficulty was experienced in getting supplies through to the workmen, particularly from St. Ignace, on the eastern division. The pluck of the officers of the road triumphed, however, over all they had to contend against, though unforseen difficulties delayed the opening fully three months later than was expected last spring. Track-laying commenced at Marquette, on the Western division, and at St. Ignace, on the other, in June, 1880, and on the 9th the rails were joined at Newberry Station, ninety-five miles from Marquette. The road is well equipped with rolling stock, and will be in superb condition for business by the opening of navigation next spring. The connecting Michigan Central line will be extended to the straits on the other side within a few weeks, when the new route to the east will become an accomplished fact. The company is now having ore docks built at Point St. Ignace, with a capacity of eight thousand tons, and will be prepared to compete for its share of the ore-carrying trade another season.

RIVERS AND HARBORS.

HARLEM CANAL.—In response to Senate resolution of the 14th inst., the Secretary of War transmitted to the Senate on the 19th a copy of the report of Col. John R. Newton, Corps of Engineers, upon the completion of the survey of Harlem River, New York, and through the Harlem Kills to East River, New York. The report was embraced in Gen. Wright's report to the Secretary of War on the 8th of October. It submits estimates of cost for a channel 300 ft. wide and 3,400 ft. long, and for 18, 15 and 12 ft. depth. For the former, $3,484,400; for 15 ft., $2,204,409, and for 12 ft. $1,161,225. The report recommends a depth of 15 ft. as sufficient for the purposes of navigation.

THE JETTIES.—NEW ORLEANS, Dec. 18.—At the last meeting of the Chamber of Commerce a committee was appointed to investigate and report on the depth of water and facilities for the promotion of the commerce of the city. Accompanying the committee on their investigation were Captain Leathers and John Cowden, strong opponents of the jetties, and their engineer, Benjamin McLain; Captain Eads and the United States engineers also had representatives. They anchored the boat on which the committee was, and soundings—thorough soundings—were taken at all points in the jetties and over the bar. Captain Cowden held one of the leads, and Mr. John Henderson, chairman of the Chamber of Commerce Committee, took down his figures, which were accepted by the committee. The report of the committee was made public to-day, the general results of its labors being summed up in the following paragraph, which I extract: "Your committee continued to make soundings through the jetties and across the bar at the mouth of the river, on the bar and outside of the bar in the gulf, and at no place found less than twenty-six feet of water in the channel and across the bar." The committee explains that when the soundings were taken the water in the jetties was fourteen inches below the average flood-tide.

REPORT OF THE COMMISSION.

WASHINGTON, Dec. 15.—The Senate to-day received from the Secretary of War the annual report of the Mississippi River Commission. It covers the progress made in surveys and examinations from the date of the last report, Jan. 8, 1881, up to Oct. 10, 1881. During this period triangulation of the river has been completed from Arkansas City, Ark., to Greenville, Miss., where it joins the coast survey. The river is not triangulated from Keokuk, Ia., to the Gulf of Mexico. The lines of precise levels are complete between Keokuk and New Orleans. With the remainder of the present appropriation it is hoped during the coming year to complete the final topography and hydrography from St. Louis to Vicksburg and complete the work of ascertaining the lines of levels across the alluvial bottoms of the Mississippi. The commission report they have expended $144,000 for surveys from Dec. 11, 1880, to Nov. 19, 1881, and have a balance of appropriations on hand of $111,000, which, it is thought, will be expended during the remainder of the current year, ending June 30, 1882. The estimates for the next fiscal year for surveys, etc., call for $200,000. The works of improvement contemplated under the existing appropriations include channel improvements upon two reaches, the first lying between Cairo and Memphis, a distance of 145 miles, to the second, between Skipwith's Landing, La., and Island No. 95, a distance of 25 miles. It is the unanimous opinion of the committee that improvement and navigation of the Mississippi below Cairo upon the general plan recommended in their report of Feb. 17, 1880, is entirely practicable, and that completion of the work for which partial estimates were then submitted will establish a continuous low-river channel, not less than 10 ft. deep, over all shoals and bars between Cairo and the head of the passes, with the possibility of attaining practical depths considerably beyond that limit. The commission estimates the total cost of improvements needed in the Mississippi at $33,000,000. Of the $1,000,000 appropriated by the act of March 3, 1881, $250,000 had been expended up to Nov. 25, 1881, and the remainder, $750,000, will, it is thought, be expended during the present fiscal year. For the next fiscal year $3,113,000 is asked, to construct a channel and protect caving banks on six reaches of river, 184 miles in length, and $1,010,000 for closing existing gaps in the levees.

On the subject of the levee system the commission repeat the conclusions submitted in their report of February, 1880, in which they say, among other things, that in the restricted sense, as auxiliary to the plan of channel improvement only, construction and maintenance of the levee system is not demanded, but in the larger sense, as embracing not only beneficial effects upon the channel, but as protection against destructive floods, the levee system is essential, and would also promote and facilitate commerce, trade and postal service. The commission renew the recommendation contained in the former report, that provision be made by law for appropriations of land or material when needed in the improvement of the river and not otherwise obtainable. It is recommended that authority be given the commission, or person in charge of work, to apply to the United States District Courts for condemnation of land or material and assessment of damage to owner. In addition to such legislation it is recommended that Congress declare to what extent river shall be under control of the commission during progress of the work, and under what circumstances and to what extent material found on bars and islands within the banks may be used without compensation to riparian owners. The control of reclaimed land, that willows, etc., may be planted to carry it up by deposit to high-water mark, is considered essential. The same is true in relation to the grade of service which may be given to the caving of the banks. Protection by suitable legislation to boats, machines, tools, etc, required for the work, is also suggested.

NEW PROJECTS.

There is a corps of engineers in the field now surveying a line from Dallas to this place for the Texas & St. Louis Railroad.

The Chicago, Mount Vernon & Southern Railroad Company of Illinois filed articles of incorporation Dec. 19. Capital $3,000,000.

GREENVILLE, Tex., Dec. 15.—A large force is now at work on the East Line Railroad, between here and Farmersville. The whole line is under contract. About one-third of the line is graded, and track-laying will begin in a few days. Large quantities of rails are being daily received here.

William Bannerman returned to Winnipeg on the 19th inst. with the remainder of the party employed in surveying the route of the proposed railroad to Hudson Bay. He is sanguine in regard to the enterprise. Active preparations will be commenced early next year. The Air Line Canada Pacific Railway has been completed between Winnipeg and Portage La Prairie. The road was officially opened on the 20th.

An English company has bought 2,000,000 acres of Florida lands from Mr. Hamilton Disston, of Philadelphia. Sir Edward J. Reed, member of Parliament, who is the representative of the purchasers, is a wealthy Englishman who has large interests in America, and who is engaged in building the Atlantic & Gulf Coast & West India Transit Railway, which runs from Fernandina to Cedar Keys, in Florida. On the consummation of the purchase, he and his friends started immediately for Florida, where they will at once organize a land company, whose headquarters will be in England. This company will be conducted in connection with the railroad companies, and it is expected the land will be settled rapidly by English and Dutch emigrants.

The details of the new scheme of a new air line railroad between Boston and New York, hinted at from time to time, and in the interest of which several of the engineering parties in the field the past few months are said to have been, are made public. The entire survey, it is stated, is now completed between Charles street, Boston, and Mount Vernon, Westchester County, N. Y., 12 miles from the Grand Central Depot. The distance of the new road to be built to its connection with the Harlem is 177.33 miles. The line as surveyed begins at Charles street, Boston, crosses Beacon street at the junction of Brookline avenue, crossing the Boston and Albany Railroad at nearly right angles, passing through the southerly part of Brookline, and from there Needham, Dover, Midway, Milford, Northbridge, near Whitings in Uxbridge, and Douglass, in Massachusetts. From thence through Putnam, north of Willimantic, Middletown, Wallingford, and Birmingham, in Connecticut, to the State line of New York, in the town of Rye. Thence direct to Mount Vernon, about 12 miles distant. The surveys show about seven tunnels, with an aggregate length of about five miles. It is estimated that the entire cost of building, equipping, and securing the right of way of the new railroad will be in the aggregate $50,000,000, for which the funds, it is stated, have been provided in the form of stock and bonds. Contracts are now being entered into for the completion of the work on or before June 1, 1885. The corporate name of the company is the New York & Boston Inland Railroad Company. The charter for the State of New York was taken out and received from the Secretary of State about two months ago. In the State of Connecticut it is said that the stock has been subscribed for according to the legal requirements of law, and papers will be filed with the Secretary of State there in about two weeks. In Massachusetts the required amount of stock has been subscribed for, the corporation has been organized, officers have been elected, and plans and specifications will be filed with the Secretary of State during the coming week. The charter from this State was obtained last winter, under the title of the New York Construction Company, and at that time an outline of the scheme as far as possible was given. Under it there has been organized a corporation with a paid-up capital of $12,000,000, with a guarantee capital of $12,000,000. This corporation was organized about eight months ago, with authority to subscribe for and take securities in stock and bonds, make surveys, estimates, plans, build, furnish, and equip the whole or any part of the proposed railroad in the States of Massachusetts, Connecticut and New York.

It is proposed to run five daily express trains on this road, for through business each way, making no stops whatever between New York City and Boston, on a schedule time of four hours, and to run as many local trains as business may require in order to give local travel good accommodations, and also as many freight trains as the business shall demand, making the time of express freight trains between New York city and Boston eight hours. It is not known at present what other railroad combination is connected with the scheme, or whether the money is furnished by English capitalists, but it is surmised that Vanderbilt may be interested.

CONTRACTING, MISCELLANEOUS, ETC.

St. Paul Episcopal church congregation at Milwaukee are about to erect a new edifice at a cost of $100,000.

Mr. Meyer, whose plans for the new Texas State capitol at Austin were accepted, has furnished plans for new lunatic asylum buildings, and bids for construction are advertised, the construction to cost $95,000.

The experimental boring by the Illinois Central Railroad Company in the Ohio River at Cairo, with a view to testing the practicability of bridging the stream, has been discontinued. The shaft was sunk to a depth of 203 feet, but without striking a rock foundation.

C. E. Briant, of Wabash, Ind., has taken a contract to furnish new ties for the Wabash, St. Louis & Pacific railroad for a distance of one hundred and fifty miles. This distance includes the track between Fort Wayne and Lafayette, and Peru and Butler.

Messrs. Henry & Dilly, who have the contract for building forty miles on the Sunset extension between Devil's River and Pecos River, Texas, passed through Palestine on the 14th with a large contingent of men, whom they had brought from Joliet, Ill., to work on contract.

ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 31, 1881.

WE use the present number 53 of this volume almost exclusively for our table of contents, and as it is a holiday season we must ask the indulgence of our subscribers for the balance of the paper sent out this week. We congratulate the profession on the present favorable prospects for business, and hoping all our readers may find in the coming year the most prosperous they have yet known, we wish them all "the compliments of the season."

A NEW, revised and enlarged edition of Plympton's Manual of the Aneroid Barometer is in active preparation and will be ready shortly. This excellent practical work has had a large sale and continues in active demand. The new edition will be an improvement upon the former in many ways, having been entirely re-written, with new tables and a description of the Goldschmid Aneroid added.

VICK'S FLORAL GUIDE.—This work is before us, and those who send ten cents to James Vick, Rochester, N. Y., for it, will be *disappointed*. Instead of getting a cheap thing, as the price would seem to indicate, they will receive a very handsome work of 130 pages, and perhaps 1,000 illustrations—not cheap, but elegant illustrations, on the very best of calendered paper, and as a set off to the whole, two beautiful Colored Plates that are worth twice the price of the book.

CONCERNING CLUBBING.—As soon as subscriptions to other periodicals are received by us we forward them with the money to the proper offices; the periodicals paid for are sent *direct* from the office of publication to the subscriber, and our agency in the matter is closed for the season; in cases of change of address write *direct* to the office of publication; we will club ENGINEERING NEWS with any other publication desired and will allow *our subscribers all the advantage*, excepting only our trifling charge for transacting the business; this is a feature of clubbing with ENGINEERING NEWS that is exclusively peculiar to it. If other agents do better it is their advantage.

ENGINEERING NEWS.

CLUBBING ARRANGEMENTS, 1882.

In order to accommodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
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Railroad Gazette (new subs.)	3.45	4.20
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Science	3.25	4.00
American Architect	4.85	6.00
Scientific American	2.65	3.20
Iron Age	3.75	4.50

PREMIUMS.—In order to stimulate present subscribers to increase our list, we offer the following inducements: For every new subscription sent us we will pay **One Dollar Cash.** By a little effort each subscriber can get his own subscription free at the same time that he assists in quadrupling our list.

We have, on the strength of the above offer, received several subscriptions from parties who sent only three dollars. We do not pay any person one dollar to become a subscriber, but once he is a subscriber at full rates, we will pay him the above premium for his efforts to add more names to our list.

INDIANA COUNTY SURVEYORS.—A card like this has been sent to each one of the County Surveyors in the State, and we think the majority of them will be present:

SIR. The second meeting of the Association of County Surveyors and Civil Engineers of the State of Indiana will be held at the Surveyor's office, in the Court-house, in Indianapolis, on Tuesday, Jan. 17, 1882. Several discussions are expected, which may be of interest to surveyors.

You are earnestly invited to be present.

HERVEY B. FATOUT,
Corresponding Secretary.

PERSONAL.

Prof. J. E. Hilgard has been appointed superintendent of the coast and geodetic survey.

Henry C. Wentworth, for twenty-five years the General Passenger Agent of the Michigan Central Railroad at Chicago, is dead.

George E. Parkhurst, Mechanical Engineer, of Woburn, Mass., was sent out to St. Petersburgh, Russia, to superintend the erection of the two B'ake pumps sent to that city.

A. J. Mathewson, C. E. of Lockport, Ill., has commenced suit against the Joliet & Valparaiso Railroad Company for $3,000 for services rendered as surveyor.

Colonel John W. Glenn, supervising architect of the new post-office and United States court-house building at Austin, Tex., has been appointed to supervise the construction of the custom-house at New Orleans.

General William McCrae has resigned the position of Superintendent of the Western & Atlantic Railroad, and Robert Anderson is elected to fill the vacancy. Joseph M. Brown, a son of Senator Brown, is made General Freight Agent.

The reports about the retirement of Mr. W. H. Vanderbilt go a little further than his real intentions. He will remain nominally at the head of his enterprises, but he has about decided to relinquish in the coming year much of the responsibility and care of their management to his very capable son Cornelius. The coming Vanderbilt is about thirty-eight years of age, vigorous in body and mind, very industrious and now quite experienced in railroad affairs.

CURIOSITIES OF THE LAW.

A street car passenger asked the driver to let him off at the Palmer House, which the driver promised to do, and when the car drew near the spot the driver beckoned to him and said, "Here is your place," and slowed up the car, as if to stop. The passenger went to the rear platform, and when the car was moving very slowly, stepped off: but at that instant the driver, who apparently thought the passenger had already alighted, whipped his horse, the car gave a jerk, and the passenger, who had not yet let go the iron rail, was thrown violently to the ground, crippling him for life. He recovered $5,000 damages from the company, and the Court said this was not too much. As a general rule, the driver is bound to stop the car entirely, and if passengers jump off while a car is moving, they take the risk of being hurt: but this does not apply where the driver slows the car enough to render stepping off apparently safe, and invites the passenger to do so, but starts the car forward without giving him time.

The arrangements of a railroad terminus in Austin, Tex., are such that the train makes a short stop in a freight depot first, and then runs onward to the passenger depot. One passenger, not understanding this peculiarity, alighted from the cars while they were in the freight depot, supposing that to be the proper place for him to get off. There were no lamps in or about the freight depot—none probably were needed for the work done there—and the passenger, groping his way along the platform as well as he could, had a fall of about six feet, sustaining serious dislocations and bruises. The company said that he was not entitled to damages, for a railroad is not bound to light up its freight depot, nor is it under any obligation to take care of a passenger after he has left the train at his place of destination. But the Court said that it is bound to provide safe, convenient accommodations for passengers to get fairly off from the platform and grounds of the station, and that therefore the suit would hold.

HYDRAULIC MINING IN CALIFORNIA.

The development of hydraulic mining in California is causing the ruin of some of the most fertile farming regions in that State. The miner turns his resistless nozzle upon the hill-sides to wash out the scattered nuggets and grains of gold, and the débris of sand and gravel, incalculable in amount, sweeps down the gulches and river-beds, and the annual freshet spreads it over thousands of acres of valley lands. There appears to be no limit to this process. The miners are prepared to wash down even the Sierra Nevada itself should the mountains contain enough "pay gravel." The farmers are naturally alarmed, and the débris question has become an issue over which public meetings are held, and recently several committees of investigation have made reports upon the soil which, have been printed in the California papers. The country on the Feather River between Marysville and Wheatland, once the garden of the State, has been nearly turned into a desert by the "slichins" of the hydraulic miner. An instance of the rapid depreciation of property in this locality is afforded by the Plumas ranch of 4,000 acres, which a few years ago sold for $75,000, later for $24,000, and still later for $6,000, and the last purchaser will probably lose all he paid. Some idea of the vast bulk of the débris turned loose may be gathered from the fact that one mining company alone washed 300,000 cubic yards of earth into the Feather River inside of 40 days. The rivers, choked by the débris, are continually seeking new channels, and once-productive farms have become buried in rubbish 2 to 20 ft. in depth. The adjustment of this conflict between the farmers and the miners is beset with various difficulties. The mining interest is a large one, but the farmers cannot be expected to calmly suffer further ruin. Levees have proven worthless; the latest effort to hinder devastation has been the turning of the débris into mountain cañons dammed to retain its accumulation.

EFFECT OF AMERICAN CEMENTS ON WROUGHT IRON.

It has been long considered that embedded in cement, the preservation of iron was assured. It would appear from the following letters, that this may be seriously questioned:

WASHINGTON, Nov. 8, 1881.

To the Editors of the American Architect:

I now, November, 1881, find a welded iron water pipe, laid in a cement concerete floor in the year 1869, honey-combed and leaky. The plumbers tell me that it is their experience that American cements corrode iron—uncoated iron—more rapidly than that protected by a coating of zinc—galvanized iron as it is commonly styled.

This is of importance. Fire-proof buildings of great cost are built by the United States and by merchants, in which all the floors are of rolled I-beams supporting brick arches laid in cement mortar, and joints of cement are laid in contact with the iron beams, whose vertical webs are not very much thicker in some cases than are the welded iron pipes used in domestic water supply.

Such floors seem, therefore, to have in them, if cement corrodes wrought iron, the means of ultimate decay and destruction.

Wrought iron built into a wall laid in lime mortar appears to be indestructible. I have myself tried in vain to pull out from a brick wall in a hippodrome in Rome, built under the emperors, a wrought-iron clamp whose stem was not larger than $\frac{3}{8} \times \frac{3}{8}$ inch, of which one end was exposed by the crumbling of the brick wall. It was perfectly clean, sharp in the edges, free from all rust or corrosion, and very soft and tough. That small bar of iron must have been buried in that brick-work for 1,500 years.

A leaden drain-pipe, $1\frac{1}{2}$ in. diameter, has lately been taken up in my basement, of which for over 12 in. in length the rats had cut away one-half. The marks of their teeth upon the cut edges showed unmistakably the authors of the mischief.

M. C. MEIGS.

ELEVATED RAILROAD STATISTICS.

Before the Supreme Court Commission in the matter of the Steam Transit Elevated Railroad, Brooklyn, the following evidence was introduced in reference to value of property in this city on the line of the elevated roads, before and since their construction: Colonel John H. Bergen said: "I offer in evidence affidavits made by John W. Carroll and William H. Dongan, which contain carefully prepared statements taken from the assessor's books of the city of New York of the valuation of property on the line of the Manhattan Elevated Railroad from New Church and Morris streets to the end of the route, and on Third avenue from Chatham square and Tryon row to the end of that road. These statements are in figures and they are given by blocks on the entire route of those two roads. There is a comparative statement which shows the assessed valuation of the property on the line of those two roads, giving the valuation in 1877, the year before those roads were constructed, and also in 1881, this present year, showing the difference in value between those two years. They show that on the Third avenue route the increase in valuation on that line from 1877, the year before the road was built, and 1881, was $2,423,800. That is on the Third avenue road. On the Sixth avenue route, from Morris street, which, as you are aware, is very low down town, up to the end of the route, the increased assessed valuation amounts to $7,950,900, making a total of increase on the two lines of nearly $11,000,000.

A large number of documents, signed by 14,700 residents and property owners, petitioning for the building of the road on the route laid out by the Mayor's commission, were put in evidence, and the commissioners then adjourned until Monday, the 28th inst., at 1 o'clock.

NOTE.

THE GENESEE FALLS MOTOR.

For the past three weeks, James M. Bois, president of and practical engineer for the Hydraulic Motor Company, has been quietly but steadily perfecting the details in the mammoth machinery at the lower falls of the Genesee River, for the purpose of condensing the air that is to be used for the company's motive power. The final fitting together of the large pipes and the construction of the flumes have been completed, and the machinery has been found to work smoothly and successfully. The compressor, the machine that has been so long on the way from Norwalk, Conn., has arrived, and now lies on the Central freight platform, just west of State street. It is a very heavy machine, thirty thousands pounds in weight, and is of immense power. It is to be taken to the works as soon as possible, and lowered over the bank, which will be a great undertaking. When the compressor is at the required spot, it will require but a few days to make the necessary connections with the other machinery, and, if the weather permits, the people of Rochester will see the car running over the street-car tracks by means of compressed air within three weeks. To give some idea of the power obtainable from the machinery, it is stated as a fact that the actual weight of water that will flow into the pipes each minute is six hundred tons. This falls a distance of over fifty feet.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Portsmouth, Va., is discussing water-works.

Kalamazoo, Mich., is to be lighted with Brush electric lights.

The water-works improvements of the town of Lake, Cook Co., Ill., will cost $250,000.

Ludington, Mich., is to have water-works as soon as the weather is favorable for work to be prosecuted.

The City Council, of Cleburne, Tex., have entered into contract with M. H. Warren, of Fort Worth, for the boring of an artesian well on the public square. There is great confidence that flowing water will be found.

The town of Bristol, R. I., voted on Saturday, the 17th, to grant George H. Norman the exclusive right to introduce water into the town. The action of the town in voting to introduce water had a marked effect on public sentiment, and apparently but few taxpayers opposed the movement, which had gained strong headway ere the town took decisive action.

W. R. Coats, of Kalamazoo, Mich., who is making a survey for the location of water-works in Mattoon, Ill., said that he felt sure of obtaining a liberal supply of water at a depth of forty feet. He recommended a reservoir forty feet in diameter. The water-works complete, with six miles of pipe, would cost between $50,000 and $60,000. Before another year Mattoon in all probability will be supplied with water from a subterranean stream.

FATAL ELECTRIC LIGHT ACCIDENT.—A fatal accident occurred on Monday at Hatfield House, the residence of the Marquis of Salisbury, to a laborer named William Dimmock, in consequence of his coming in contact with the wires conveying the electric current for lighting the mansion. Hatfield House is lighted with 117 lights on the Brush system, worked by an engine of 16-horse power, placed in the saw mills some distance from the house; two electric wires and a telephone wire connect the saw mills with the house; for some distance they are carried on poles, and then placed along the garden wall. The deceased was at work in the garden, assisting to lay a telephone wire, and was sent to ease the wire at the corner of the brick-work to prevent it getting cut. Another workman heard the wires shake, and on looking around saw the deceased lying on his back, and on going up to him found he was dead. The machine was at work at the time. At the inquest the jury found that the deceased died through touching the electric wire, and appended a recommendation that there should be a stated time for working the current, and that notice should be given of it to all persons near the wires. It was stated that, to avoid similar accidents in future, the wires would all be conveyed either underground or on poles out of reach.—*From the Pall Mall Gazette, Dec. 13.*

BRIDGES.

Jackson street, Chicago, is to have a double roadway bridge.

The iron railway bridge over the Brazos River, at Waco, Texas, was successfully tested on the 22d instant.

Borings for the new bridge over the St. Lawrence at Montreal for the Atlantic & Northwest Railway are going on satisfactorily. The longest stretch is 3,000 ft. and the shortest 2,800 ft.

The winter bridge of the St. Paul & Omaha road across the Missouri River at Sioux City, connecting Minnesota, Dakota, Iowa and Nebraska, is completed, and on the 14th inst. trains on the Nebraska Division ran direct from Sioux City to Ponca and Omaha, Neb.

The Boston Bridge Works has the contract for the iron work of the new bridge over the Merrimack River, between Haverhill and Groveland, Mass., which is being built to replace the one which fell last winter. Edward S. Shaw, C. E., of Cambridge, Mass., is Consulting Engineer for the Essex County commissioners, who have the bridge in charge.

JERSEYVILLE, Ill., Dec. 24.—The miscreant that cut the guy-ropes that held the bridging in course of construction near Elsa, on the St. Louis, Jerseyville and Springfield Railroad, last Thursday night, thus causing the whole superstructure of 500 feet to fall and the timbers to break and splinter so as to be useless, has not been overtaken. The company is using every means to capture the villain. The loss is about $205,000 on Samuel Bothwell & Co., bridge builders, of this city, who have the contract. It is thought that the object in view was to prevent the company from completing their track to the Mississippi River by the 1st prox., and thus make it lose $100,000 conditional stock subscriptions. This, however, will not work, as Chief Engineer Masten will have the rails all down before the year is closed.

A temporary bridge, formerly used over some stream in Missouri, is now on the way to this city, from which it will be shipped to Laredo and put up across the Rio Grande as rapidly as possible. As soon as the bridge is ready for the trains to run over, the work will be actively commenced of laying track on the Mexican side. During the time which will be required in constructing the bridge grading will be rushed ahead, and material for the Mexican extension will be accumulated. Mr. Joe Van Wie, one of the contractors on the Mexican extension of the Sunset, is again in the city, and says that about a thousand men are now employed on the rock work in the Devils River and Pecos country. The roughest part of the work at Devil's River extends over only about 6 miles of the line, though there are 45 miles of similar work east of the Pecos. It is the general belief that the Sunset and Southern Pacific will join during next July or August. Outfits are now engaged raising the grades which were washed away in Kinney County by the heavy rains which fell a couple of months ago. The track-layers are moving ahead slowly, and have crossed Turkey Creek.—*San Antonio Express.*

RAILROADS.

The Richmond & Cincinnati Railway Company has filed articles of incorporation. The road will run from Richmond, Ind., to a point near Boston, O. Capital $500,000.

HERMOSILLO, Sonora, Dec. 23.—The railway officials to-day received advices from Mexico permitting them to proceed with the construction of the Sonora Railway on the Magdalena route. The decision is a victory for them, as that route is their choice.

Gen. M. T. Thomas, formerly assistant superintendent of the D., L. & N. Railroad, has been appointed acting superintendent of the Second Division of the Atlantic & Pacific Railroad. Gen. Thomas has recently been superintendent of track construction, and writes J. J. McVean that in forty days forty-three miles of track were laid, and the track-layers were delayed nine working days during that time waiting for bridges. He says it is fun to build railroads in that country. His present location is a very pleasant one on the backbone of the Rocky Mountains, 8,000 feet above the sea. He reports the weather beautiful, with bright sunshine and no snow or rain. The nights are cold, the thermometer being at freezing point. The Atlantic & Pacific runs from Albuquerque, in New Mexico, through Arizona, almost parallel with the Southern Pacific into Southern California, and from there on to San Francisco.—*Ionia Sentinel.*

NEW PROJECTS.

The corporators of the Pelletier Paving Company, of Chicago, with a capital of $5,000,000, are Marshall Field, Mark Kimball, B. P. Hutchinson, Cyrus McCormick, Jr., W. H. Bradley, J. B. Waller and Potter Palmer.

It is now planned to build a road from St. Cloud, on the St. Paul & Manitoba, east, crossing the St. Paul & Duluth road at Dutch City and so on through northern Wisconsin and the central part of the northern peninsula of Michigan to the Sault Ste. Marie. A bill will be presented in Congress this winter giving permission to bridge this outlet of Lake Superior.

Phillips, Marshall & Co., of London, have just concluded the purchase of 1,300,000 acres of land from the State of Mississippi. Seven hundred and sixty thousand acres are known as levee lands, and located mostly in the Yazoo delta, comprising some of the richest cotton and timber land in the South. The intention is to improve, colonize and cultivate these lands.

JACKSONVILLE, Fla., Dec. 23.—The Lengle interest in the Florida Central Railway was sold to-day to Sir Edward J. Reed, the English capitalist who has recently purchased 2,000,000 acres of land in this State, and who is reported to be negotiating for the Transit Railroad from Fernandina to Cedar Keys. This transfer gives Sir Edward a controlling interest in the Florida Central Railway, of which he was to-day elected President.

SAN DOMINGO, Dec. 14.—The news that a United States war steamer will survey Samana Bay has caused excitement to such a degree that the authorities have prepared two war schooners, the Thunderer and Capatillo, to watch the American man-of-war. Emilio Zeller, the agent of the Samana Railroad Company, and two engineers have opened about a mile of the road at Yuna, above Samana, employing 160 men. Mr. Crosby and Chief Engineer Wood, with a cargo of rails from England, are daily expected.

The Cincinnati & St. Louis Air Line railroad, capital stock $2,800,000, propose to construct a line of road from East St. Louis to the Wabash River at or near Palestine, also a branch commencing in Effingham, running northwesterly through Effingham and Clay counties to a junction with the Toledo, Burlington & St. Louis road at or near Holiday, in Shelby County. The principal office is to be at Robinson, Crawford County. The Mattoon & Northern road, capital stock $30,000, also filed articles. It is proposed to construct a line of road from Mattoon to the Midland railroad. The principal office is to be at Mattoon.

CHEYENNE, Wyoming, Dec. 23.—The *Ledger* to-day publishes a copy of the papers of organization of the Central Pacific Railroad of Wyoming, filed with the Secretary of Wyoming Territory by Charles Crocker, Charles F. Crocker, and W. V. Huntington, incorporators and trustees. The capital stock is $13,500,000 in 135,000 shares. The chief office is at Evanston, Wyoming. The road will commence on a point of the north and south boundary line between the Territories of Wyoming and Utah, where the Bear River crosses the boundary line, running thence through Uintah, Sweetwater, Carbon, Albany and Laramie counties in Wyoming, to a point on the eastern boundary line of Wyoming, where the Niobrara River crosses the same, a distance of 450 miles. The capital stock represents the actual contemplated cost of construction and of the right of way. Each trustee takes 33,750 shares.

CONTRACTING, MISCELLANEOUS, ETC.

The Newburg, N. Y., Court-house is in a bad condition and the question is agitating whether a new one can be erected.

The Crane Brothers Manufacturing Company, of Chicago, have the contract for furnishing the elevators for the new court-house of that city.

The development of the stone-quarrying interest in Indiana is proceeding so rapidly that there are now employed in the State eleven steam channelers, of which eight are in Lawrence County and three in Monroe County.

The Wabash, Ind., city treasury is now empty, and orders presented are indorsed, "Not paid for want of funds." Six per cent. interest will be paid on the orders until money from the spring tax-levy is received to take them up.

A number of contractors on the New York, Ontario & Western Railroad met at No. 48 Dey street, New York, and passed a resolution condemning the importation of cheap negro labor from Maryland and Virginia. The resolution is to be laid before all the contractors for concurrence.

The stockholders of the Scioto Valley Railroad will meet in Columbus, O., Jan. 24, to increase the capital stock from $2,500,000 to $5,000,000. The present unfunded indebtedness amounts to a figure nearly equal to the proposed increase. This company is discussing an extension into West Virginia to free itself of dependence upon the Chesapeake & Ohio, the construction of a bridge across the Ohio to take the place of the ferry, and the construction of a branch into the coal mining section of Lawrence County.

ENGINEERING NEWS.

Tribune Building. New York City.

GEO. H. FROST.....PROPRIETOR.
J. W. ADAMS.....EDITOR.

SATURDAY, DEC. 3, 1881.

A CONNECTICUT court decided last week that a limited railway ticket is worthless except for the trip specified on its face.

WITH the first number of volume 5 (Dec. 1, 1881), the *Sanitary Engineer* announces that it will thereafter be issued weekly. For the present it will contain twenty pages, the subscription price remaining unchanged. We sincerely congratulate our esteemed contemporary upon its marked success.

MR. EDWIN CHADWICK, the Sanitary Engineer, makes an official report upon the sanitary condition of England and Wales, from which it appears that, according to the death rate, the country was stationary from 1860 to 1870, but from the latter date to 1880, or for the ten years past, the death rate has fallen from 22.5 to 21.5 per 1,000, a reduction of about 4½ per cent.

AN INTERESTING CASE TO CIVIL ENGINEERS.—On the 25th ult., in the Court in General Term, the case of Desmond against the Baltimore & Potomac Railroad Company was argued by Mr. Garnett for plaintiff and Totten for defendant. Desmond was discharged from the service of the company, but was not given a recommendation, as is customary with the usage of the craft, and failing to obtain employment he sued the company for damages. On trial below judgment was given for the railroad company on demurrer, and plaintiff appealed. Chief Justice Cartter delivered the opinion of the court, affirming the judgment below.—*Washington Star, Nov.* 25.

JUDGMENT has been rendered in the case of Molson's Bank vs. The St. Lawrence and Chicago Forwarding Company. The bank held a bill of lading for a cargo of wheat, which had been transferred to it as collateral for an advance for Bedall & Co., of Montreal. The wheat arrived in port and was delivered to Crane & Baird without a bill of lading. The bank sued the forwarding company, who claimed that they were not under contract, and that the bill of lading expired when the wheat reached the port of Kingston and was transferred to barges and forwarded to Montreal. The Court held that the bill of lading continued on till the latter port was reached, and that the company had no right to deliver the wheat without it. The company was condemned to pay the value, $16,275.

ON the 29th ult. Mayor Grace, of this city, vetoed a resolution of the Board of Aldermen authorizing the Metropolitan Telephone & Telegraph Company to lay their wires under the streets. His reasons are that the resolutions fail to make any provision for the payment to the city of any adequate consideration for the franchise sought; also that the payment of one cent per lineal foot of street occupied is scarcely more than nominal; only one wire in each route would be reserved for the use of the police and fire departments. A further objection is made that the petitioning company is only one of a large number who would claim the same right; and as the streets are now largely occupied by gas and water pipes, sewers, railroad foundations, etc., there would be no place, in many streets, for more than a few wires. It is further stated that such a privilege should only be granted after a careful consideration of the requirements of the entire telegraph system of the city, with a view to its future development.

MR. S. S. THOMPSON, the Superintendent of the Allentown, Pa., Water-Works, in complying with the request for statistics of his works for incorporation on "The History and Statistics of American Water-Works," which has been in course of publication in our columns since March last, adds that he has "sent a good many reports to different parties, but has never seen any published."

We have no doubt that the same feeling of uncertainty as to the publication of the statistics, which Mr. Thompson evidently felt, has deterred many officers of water-works from sending the data asked for. There are a good many blanks for statistics which have been sent out by Mr. Croes, with a stamped envelope inclosed for return postage, to which no reply has been received.

If this should meet the eye of any superintendent who has received such a document, we would suggest to him that he follow Mr. Thompson's example and send the blank filled out, and also all printed reports he may have to spare, to Mr. Croes, and we will promise that the information shall be published at once and made available to all water-works officers who take this paper.

THE FORTH BRIDGE.*

After much labor and study the engineers, Messrs. Fowler and Baker, and the consulting engineers, Messrs. Barlow and Harrison, a plan has been elaborated and determined upon for the Forth bridge, and although the writer in *Engineering*, from whom we quote, takes some pains to convince his readers, by illustrated reference to the works of savages and semi-savage people on a small scale, that the cantilever and girder principle, as well as the arch and suspension, were practiced in the early ages of civilization, if not in prehistoric times, and refers to a drawing by Lieut. Davis, R. N., made when on an embassy to an Oriental court, in 1800, and published then in London, as illustrative of the antiquity of this form of bridge, and adds, "making allowance for differences of material, the preceding work may fairly be looked upon as the prototype of the proposed Forth bridge," yet, notwithstanding all this, we must be permitted to regard the new Forth bridge as something novel in bridge architecture. To think otherwise would be equivalent to regarding our East River bridge as a very simple affair indeed. Does not the housemaid stretch her line between posts and hang her clothes on the catenary? and by no means unconscious of the increased strain brought on the line thereby. The whole principle of the suspension bridge indeed; but the scale upon which the modern engineer has ventured to utilize this principle gives his work the claim in reality, though not technically, of an invention. So of the new Forth bridge, a continuous trussed girder covering a space of 3,750 feet, in two spans, with trussed frames 350 feet in height over the pier, may well cause us to hold our breath in amazement.

As we regard it, in our simplicity, it would improve it possibly, as a design, if it were turned bottom upward. But in this we will yield to better judgment, and quote as follows:

A glance at the preceding illustrations and description will satisfy our readers that there is nothing novel or untried in the principle of the structure designed for the Forth crossing. It must be conceded, however, that except as regards principle the design is essentially novel, but the novelties are dictated by the unexampled size of the structure, and are due simply to the perfect adaptation of the principle of the continuous girder and the general laws regarding the strength of materials to the special conditions of the case. Thus it will be observed that the structure is a continuous girder of varying depth on plan as well as elevation, the central girder portion being of the ordinary width required for a double line of rails, and the cantilevers spreading out to an extreme width of 112 ft. at the piers. By this means the stresses on the horizontal bracing from wind pressure are much reduced, and lightness and compactness are attained. To further the same ends the whole of the vertical members are made of two struts inclined towards each other from base to summit and braced together. To reduce the extreme height of the structure, and bring the center of gravity as low down as possible, the bottom members of the continuous girder are curved, springing from solid masonry piers at a height of 18 ft. only above high water, whereas in the original design the main chains, carrying of course all the weight, were supported at a height of 550 feet above the same point! The main compression members are steel tubes ranging up to 12 ft. in diameter, the tubular form being adopted for two reasons; first, because experiments have shown that inch for inch the tubular form is stronger than any other, and, secondly, because the amount of stiffening and secondary bracing is thereby reduced to the lowest percentage. It might be thought that columns 350 ft. in length were an untried novelty, but this is not so, as we have the precedent of the Saltash bridge oval tubes 16 ft. 9 in. by 12 ft. 3 in. in diameter and 460 ft. in length, the strain upon which under the test load was higher per square inch than will be that on the steel columns of the Forth bridge. The central girder portion is simply an ordinary double-line railway bridge of 500 ft. span with girders of a type intermediate between the girder of parallel depth and the bowstring. This is an economical type, and many Continental bridges have been so constructed, among which may be mentioned the Kuilenburg bridge of 592 ft. span, the Bommel of 408 ft., and the fine bridge across the Waal near Nijmegen, which includes three spans of 426 ft. with main girders in less than one-sixth of the span, or 71 ft. in depth.

The chief desiderata in the Forth bridge, which is the largest railway bridge ever yet proposed to be built, are as follows:

1. The maximum attainable amount of rigidity, both vertically under the rolling load and laterally under wind pressure, so that the work when completed may by its freedom from vibration gain the confidence of the public, and enjoy the reputation of being not only the biggest and strongest, but also the stiffest bridge in the world.

2. Facility and security of erection, so that at any stage of erection the incomplete structure may be as secure against a hurricane as the finished bridge.

3. That no untried material be used in its construction, or, in other words, that no steel be employed which would not comply with the requirements of the Admiralty, Lloyd's, and the Underwriters' Registry, as determined by the experience gained in the use of many thousands of tons of steel plates, bars and angles for ship-building purposes.

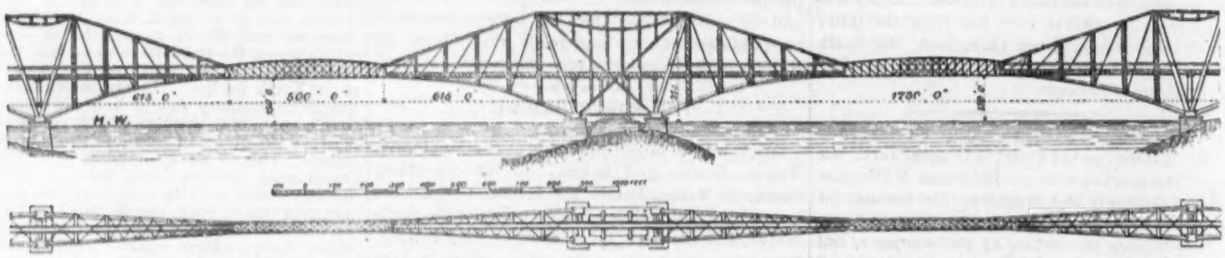
4. That the maximum economy be attained consistent with the fulfilment of the preceding conditions. We think it will be apparent to most engineers and bridge builders that the original suspension bridge design complied with none of these conditions, while the girder design complies with all.

As regards rigidity each span is calculated to carry a rolling load of 3,500 tons, and the deflection under the passage of an ordinary 400 tons goods train would be little more than an inch in the 1,730 ft. span, and should the wind ever blow with a force of 30 lbs. per square foot over the whole surface—a pressure probably sufficient to derail any train in motion—the lateral deflection would be the inappreciable amount of 6 in., or in other words the rails would be curved laterally to a radius of 140 miles. As regards erection the cantilever portion would be built by overhang, each successive bay being added and braced together vertically and horizontally with the permanent bracing as the work proceeds. Experience has amply proved that few contingencies attach to this mode of erection. One of the most recent examples is Mr. Shaler Smith's fine Minnehaha bridge across the Mississippi, having a center span of 324 ft., erected by overhang, and two side spans of 270 ft. with girders 30 ft. deep. No temporary works were used for the central span; but in arches, of course

* For the location and the specifications of this bridge, as designed by the late Sir Thomas Bouch, see page 24, vol. VII., ENGINEERING NEWS.

heavy and costly back ties have to be provided, and the difficulties in joining up the overhanging halves were found in the instance of the St. Louis and the Douro bridges to be not inconsiderable. In the Forth bridge these would not arise, and the details of the operations are of the simplest character.

As regards material, nothing but the highest quality of Bessemer or Siemens steel, as used for riveted work in shipbuilding, will be employed, and the strain will be limited to 6¼ tons per square inch. It has already been stated that the continuous girder bridge proved on investigation to be the cheapest type of construction for the Forth bridge, and therefore it may be said that the whole of the desiderata are attained in that design. Of course the details are subject to modifications, as the borings and other preliminary works are still far from complete, and as already stated certain modifications suggested by Mr. Barlow and Mr. Harrison have been accepted by all parties. The matured design will, however, not differ in any essential point from that now illustrated. It will undoubtedly be a relief to engineers, contractors and railway companies alike to be finally quit of the suspension principle, and to have to deal only with the well-tried girder system. Experience has proved that whatever previous calculation may indicate, the amount of vibration pertaining to the suspension system is in practice always excessive. The antecedents of the latter type are not encouraging. Thus, the gatekeeper of the Menai suspension bridge stated that during the storm of Jan. 23, 1836, the undulatory motion of the platform at a point midway between the center and the pier was no less than 16 ft. In contrast with this, it may be mentioned that the maximum movement of the Britannia tubes during the heaviest gales, as observed by Mr. Edwin Clark, was only ¼ in. Whereas, as in the case of the Niagara bridge, the only railway suspension bridge in the world, although stiffening girders, inclined ties, and other arrangements are introduced to mitigate oscillation and wave motion, it is found that the combination is too lively to permit of the transit of high-speed traffic. A load limited to a single train, and a speed limited to a walking pace, necessitate a very different structure to a test load of 3,500 tons and a working speed of a Scotch express, especially when one structure crosses a sheltered inland gap and the other an exposed estuary. It will not fail to be observed by practical erectors that the girder bridge is made good by lateral bracing piece by piece as the work proceeds, while a suspension bridge would be swaying about in an imperfectly secure condition until the whole structure was complete. Great responsibility and anxiety must attach to the engineers and contractors of this gigantic work however carried out, and we feel sure that engineers generally, both in this country and abroad, will join with us in hoping that a great success may be achieved.



Deflection from 3,500 tons rolling load on each span...9 ins.
Lateral deflection with 30 lbs of wind.....6 ins.

Maximum strain on girder 6¼ tons per square inch.

THE FORTH BRIDGE.

THE SEWERAGE OF AMERICAN CITIES AND TOWNS.*

We make no apology to our readers for filling a large space for several successive numbers in ENGINEERING NEWS by discussions on the subject of drainage and sewerage. The determination of the question of systems of sewerage, that are best applicable to the needs of cities, is too important to life and health not to demand our first attention, and we shall notice, as briefly as the importance of the subject will permit, such reports of engineers as come to hand, tending in any way to develop the true principles which should be our guide in this matter.

In a previous number of ENGINEERING NEWS we referred incidentally to the report of Mr. Latrobe as indicating a "one-sided view of the question of utilization of sewage." The report is able and exhaustive, and in general may be considered as representing the claims to public consideration of the rival systems of sewering cities very fairly, but is open to the objection that whatever merit or success has attended the operations for many years past of the "combined system" in many populous cities, both on this continent and in England, is made to give way to the successful working, during a limited period, of the separate system, but partially carried out in a single city of our own country. That the separate system is applicable to villages and towns of limited extent, and where the increase of population is neither uncertain in extent or direction, we admit; and the operation of the flushing tank at the head of all branch sewers, which is made an essential, as we understand it, in the separate system, is also admirable in such places; but its application in our northern climate, to large cities, with the habits of our people and the system of police, which appears inseparable to our government of large cities, renders it of more than questionable advantage in such localities; and the town of Lennox is cited in the report where the separate system is said to work well, but without flushing tanks, the roof water being admitted to the sewers and keeping them clean and pure. This is what we claim would be the effect of the combined system were it carried out with that attention to detail in construction and management, which the advocates of the separate system call for as necessary to success, and which they consider is but a small requirement in view of the great advantages otherwise offered by that system, and possibly this is so, but, unfortunately, daily experience shows us that such niceties as are necessary to its success are in practice utterly unattainable with us. As regards the earlier advocates of this system, we confess to having been in error. If Mr. John Philips claims to have been the originator and proposer of this system for adoption in London, we have not read him aright. He undoubtedly advocated the use of much smaller sections of sewers, as also pipes, at a time when the least dimensions of a sewer was what would admit men and barrows for the purpose of cleansing; and his evidence before the Metropolitan Sanitary Commissions in 1847-48, printed for Parliament, now before us, is a most admirable paper. From the formula for the discharge of running water, to the proper form and construction of sewers with their working, is so exhaustively considered that our present accumulated experience of 34 years adds nothing of value to the evidence there given. Even some of our modern inventions, notably the curvette, lately recommended for concentrating the dry-weather flow of large sewers, was not only suggested by him, but had been actually tried and found very satisfactory.

On page 49 he says: "that for the branch sewers, the smaller they are (provided they be large enough to receive and carry off storm waters in addition to the ordinary run) the better." On page 63 he states as follows:

"In laying out the drainage of an undrained town district, I would in the first place make a correct plan"—here he describes the operations preliminary, much as we now carry them out, in the combined system—"the lines of sewers all communicating with each other upon a uniform system of levels," and then proceeds to say: "The capacities I would then regulate (after providing for their extension to other districts, and for carrying off the back waters of the natural area), progressively from their head to their outfalls, and according to the number of houses, quantity of water, and area to be drained by each sewer, allowing them to be of sufficient capacity for receiving and carrying away rains and storm waters," not one word in his entire evidence before this commission, can be construed into advocacy of a *separate* system, although clearly so, for comparatively small sewers. Subsequent to this, in 1849, however, we find it stated that Mr. Philips prepared a plan for the drainage of London, in which he laid down the principles of new drainages on the "separate system," and finding, as an essential, "that at the main outlet a depôt should be formed, and works established, for raising the sewage, and connecting and distributing the same for agricultural purposes."

It will be perceived that the economic value of sewage formed an element in the system of drainage as proposed by Mr. Philips at that day, and whether the failure of any known method of utilizing city sewage modified his views or not, we are unable to say; but when the commission was appointed in 1856 to consider the plans offered for the main drainage of the metropolis, his plans did not come up for consideration. The report of this commission was made July 31, 1857, and was most extended in its scope, furnishing indeed matter for all subsequent inquiries in this direction, and we are not aware that anything since has been added to our stock of practical knowledge on draining and sewering of cities. There were one hundred and thirty-eight plans submitted to this commission, several of which embodied the principles of the separate system. Their report upon this branch of the subject will be found in our last issue (page 475), which set at rest the question of its applicability to London at least. But it is remarkable that if Mr. Philips or Mr. Rawlinson supported these views, neither of them should have appeared before the commission in advocacy of them. There were one hundred and sixty-three witnesses examined, either voluntarily or on call, and though Mr. Rawlinson appears in the list among the many professionals of the day, his

* Report to the Mayor and City Council upon a plan of Sewerage for Baltimore, Md., 1881, by C. H. Latrobe, C. E.
Report on the Sewerage and Drainage of the City of Stillwater, Minn., 1881, by D. W. Cunningham, C. E.
Report upon a System of Sewerage for the City of Elmira, N. Y., 1881.
Report to the City Council of the City of Quebec, by their Engineer, Chevalier C. Baillairge.

testimony has no reference to this branch of the subject, and his last publication, under the Public Health act of 1875, viz., "Suggestions as to Main Sewerage Works," which as an official document emanating from the Local Government Board, London, and from an engineer "beyond question foremost in his profession in England," may be taken as embodying the principles and practice of sewering as now practiced there.

(TO BE CONTINUED.)

CIVIL ENGINEERS IN THE NAVY.

Several changes in the personnel of the corps of civil engineers in the navy yard have recently taken place.

The four senior officers have been transferred to the "retired list," by reason of age, and four new appointments have been made to fill these vacancies.

The retiring civil engineers are: W. P. S. Sanger, a veteran of some 50 years continuous service in the navy, and since 1842 the civil engineer of the Bureau of Yards and Docks at the Navy Department; B. F. Chandler, whose appointment in the service dates back as far as 1852, late the civil engineer of the New London naval station; Norman Stratton, formerly of the New York navy yard, but on sick-leave for three years past; and Calvin Brown, an engineer well known on the Pacific coast, and civil engineer of the Mare Island navy yard for the past twelve years and more.

These officers have been retired from active service under the general retiring laws of the navy, in accordance with a late opinion of the Attorney General declaring the civil engineers of the navy to be regular naval officers, established by law as a staff corps of the navy, and entitled to retirement from active service upon reaching the age of 62 years, in the same manner as all other naval officers.

In anticipation of these retirements, and to secure the best qualified of the many applicants for the vacancies, the Secretary of the Navy under date of July 14,1881, issued general "Regulations governing the appointment of Civil Engineers in the U. S. Navy," restricting the age of candidates between 25 and 37 years, and requiring them to pass a satisfactory physical examination before a board of medical officers of the navy, and a satisfactory professional examination before a mixed board of line officers and civil engineers of the navy. Candidates were also required to present testimonials of good moral character, evidences of American citizenship, and of having pursued a course of civil engineering at some professional institution, and of having had at least two years practical experience as a civil engineer.

These examining Boards were convened at the Navy Yard, Washington, Aug. 10 last, when more than a score of candidates appeared for examination by permission of the Navy Department.

Several were found physically disqualified by the medical board, and the remainder entered upon the professional examination before the other board, consisting of Capt. Semmes, Commander Phythian, and civil engineers Menocal, White and Prindle.

This professional examination was wholly written and covered a period of ten days.

Several candidates fell out before its completion, and but nine were found to have passed a satisfactory examination.

These were arranged in the order of merit, and the first four were appointed and commissioned by the President, after confirmation by the Senate, at its late special session.

The successful candidates standing at the head of the list and securing the prizes, were:

1. Thomas McCollom, of Philadelphia, who was employed as assistant civil engineer at the League Island navy yard for several years, and latterly as acting civil engineer of the Pensacola navy yard, to which duty he was assigned last winter, at the urgent solicitation of the Navy Department, soon after his return from an extended tour of observation of more than a year in Europe. He is already well and favorably known in naval circles.

2. Christopher C. Wolcott, a graduate of West Point Military Academy in 1867, who resigns his commission of first lieutenant, 3d artillery, U. S. Army, to accept a higher one in the navy, and in a professional corps and duty much more to his liking. He is also a graduate of the Artillery School at Fortress Monroe, and has been engaged in connection with some scientific experiments under the Navy Department at the Washington navy yard. At the time of his appointment he was stationed with his battery at Fort Niagara, N. Y.

3. Frank O. Maxson, of Washington, who graduated at the head of the class in civil engineering of the Sheffield Scientific School at Yale College in 1872. After spending a year in teaching mathematics and natural sciences at the Norwich Free Academy, he pursued the post graduate course in civil engineering at Yale, where he also acted as instructor in surveying and mathematics, and in 1874 he became engaged upon the government surveys west of the 100th meridian under Captain Wheeler's corps of engineers, U. S. A., where he served continuously and with great acceptance until his present appointment in the navy.

4. Robert E. Peary, of Washington, who graduated at the head of his class in civil engineering at Bowdoin College, and has had some varied experience in railroad surveying and engineering.

These changes mark a new era in the history of this corps, as the combined result of long and patient effort to effect a supersedure of the old methods of favoritism and political influence in making appointments by a competitive professional examination, now for the first time introduced by the present Secretary of the Navy, Hon. Wm. H. Hunt, and to secure the benefit of their rights and privileges of rank and retirement, under the laws which have hitherto been only partially applied and enforced with regard to this corps of the navy.

The corps is also to be congratulated upon this new accession to its ranks, and the profession at large upon the recognition it receives in the final establishment of a staff corps of professional officers as resident engineers at our navy yards, in the immediate charge of the important public works of this branch of the government service.

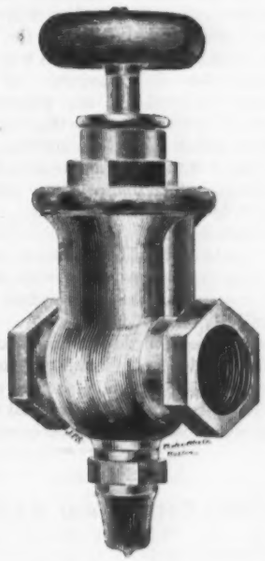
THE GEORGIA PACIFIC RAILWAY.

Last week we published an account of this road, together with a map showing its location; we now publish the following additional information which we have just received from reliable sources:

The entire line is under contract from Atlanta, Ga., to Oxford, Ala. (at which place it crosses the Selma, Rome & Dalton Railroad), a distance of one hundred miles. The contractors on this Division are: Wright & Co., Lee Brothers & Wright, C. R. Mason & Co., Perkins, Hutton & Perkins, John Kelly, and Leake & Dunn Bros. Of this one hundred miles thirty-four miles are graded. Track laying commenced at Atlanta on the the 18th ult. Twenty miles are graded eastward from Columbus, Miss., and track laying will commence at Columbus in a few days, the rails being now on the way. Thirty miles of road are in operation eastward from Greenville, Miss., with a branch of twelve miles in length extending southwardly into the Sun Flower country. No serious engineering difficulties are presented between Atlanta and the Mississippi River. There is not a tunnel on the route; the bridges are few and not costly. Surveys of the entire line are being made, and the location will be definitely fixed in a few weeks continuously from Atlanta, Ga., to Birmingham, Ala.

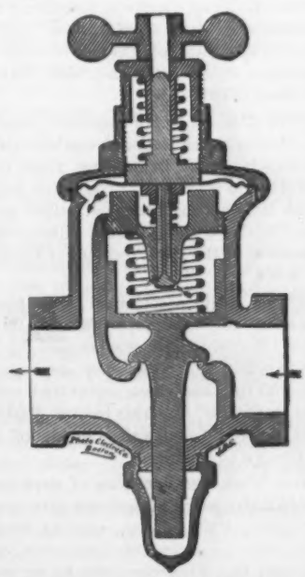
THE CURTIS PRESSURE REGULATOR.

A regulator of pressure should be simple in construction, durable, absolutely reliable, and should be free from any possible derangement of its working parts which would result in a failure to do its duty. It should be so constructed that when set the final or required pressure would be invariable,



no matter at what rate the liquid or gas was being used, and no matter how the initial pressure might vary.

The Curtis regulator, of which we herewith present a perspective and sectional view, contains a novel combination of old and established principles. It is made entirely of metal and occupies the same space as a globe valve for the same size



of pipe. It is a lock valve, is very simple in construction, sensitive in operation, and comparatively cheap. It has no glands nor packing, and the seat may be made of any material suitable for any liquid or gas.

The sectional view shows a main valve operated by a loose-fitting piston; a secondary valve in the

top of the chamber over the piston; a metallic diaphragm which performs the double office of operating the secondary valve and making a steam joint to the cap which contains it; and also a side passage connecting the chamber under the diaphragm with the outlet.

When the spring over the diaphragm is compressed, the diaphragm gives way, and thus opens the secondary valve upon which it rests. Steam from the boiler being left on, raises the piston, and therewith the main valve to its full capacity. The main valve remains open until the back pressure communicated from the outlet through the side passage is sufficient to raise the diaphragm, and thus close the secondary valve, when the steam, escaping around or through the loose-fitting piston, fills in the space on top of said piston, and forces it toward its seat, thus uniformly maintaining the pressure at which it is set. To make sure that enough steam passes the piston to produce the required pressure on the top of it, an adjustable set-screw is placed in the piston, which makes a very minute opening —a pin-hole—through the piston: this hole is always kept open.

The regulator is used on steam-heating apparatus, dryers, air-pumps, water-works systems, etc.: in fact, everywhere that gas or fluid needs to be automatically controlled.

The above-mentioned regulator is now being used upon the district steam-heating system of Lynn and Springfield, Mass., and also upon the system in this city. It is being manufactured by the Curtis Regulator Company, of 59 Beverly street, Boston.

PERSONAL.

It is stated that S. B. Reid, of Joliet, Ill., has been appointed Superintendent of Construction on the Canada Pacific.

Mr. Chas. A. Waller, late Commissioner of Public Works in Chicago, is spoken of as Superintendent of the public improvements at Pullman, Ill.

The beautiful masonry work one sees about Bath, N. Y., on the line of the New York, Lackawanna & Western R. R., has been done by Mr. W. R. Page, of Montrose, Pa.

Col. William Crooks, a prominent railroad contractor, and state senator, was married to Miss Hattie, daughter of Thomas Shields, Esq., at the residence of the latter, No. 153½ Wabash avenue, St. Paul, Minn.

Wm. J. King, a civil engineer in the employ of the Pennsylvania Railroad, was killed near Gallitzin on Tuesday last. In stepping from one track to the other to let a freight train pass he failed to notice a train approaching the other way and was knocked down and instantly killed. Mr. King was a nephew of the late President of the road, Thomas A. Scott.

It has been ascertained that the fire at the American Rubber Company's works, in Cambridge, Mass., Monday night, was caused by the friction of the belts, which set fire to rags and other material that had been saturated with benzine. The insurance amounts to over $200,000, and is held mostly by companies outside of Boston and by foreign companies.

New York has one acre of park area to every 1,142 inhabitants; Chicago, one acre to every 252 inhabitants; Philadelphia, one to every 282; St. Louis, one to every 166; Baltimore, one to every 433; and San Francisco, one to every 198 inhabitants. New York has 1,250,000 inhabitants, and a park area of 1,094 acres; Paris has 2,000,000 inhabitants, and a park area of 8,000 acres; London has 4,000,000 population, and a park area of 15,000 acres.

Sir E. J. Reed, a distinguished English engineer, is expected to visit the city to-day on his return from the South. It is stated that one of the objects of his visit is to examine into the Huron & Ontario Ship Canal Scheme, and the new lift-lock which is associated with it. Sir E. J. Reed's name is well known in connection with the construction of ironclads for the British and Russian navies, as well as for many other important engineering works. It is rumored that a reception will be tendered him during his stay in Toronto.—*Globe, Nov.* 30.

Jas. P. Weller, a civil engineer, of Wilkesbarre, Pa., was to be married to Miss Bessie Norris, on the 22d ult. Everything was arranged for the ceremony, when a note from Weller informed the prospecting bride that her lover had run away. Miss Norris is lying in a critical condition, and fears as to her recovery are entertained. Weller repented and returned in two days, and notwithstanding some family opposition it is expected the marriage will yet take place.

We take much pleasure in announcing that George O. Manchester has been elected General Manager of the Leavenworth, Topeka & Southwestern Railroad, with headquarters at Topeka. Mr. Manchester is well-known throughout Kansas and all over the country as the Assistant General Manager of the Atchison, Topeka & Santa Fe, a position which he has filled with signal credit. He will bring to his new work a valuable experience, and a reputation second to that of no man of his age in the railroad business. A better selection could not have been made, either in respect of capacity or for the satisfaction of the public. The new road will be a popular road, we are quite sure; and the owners and directors are to be congratulated upon their good luck in securing a man so admirably adapted to the management of their enterprise. Mr. Manchester assumed his new position Dec. 1, and it is expected that the road will be in operation to Topeka by the 1st of March. —*Topeka Capital, Nov.* 24.

Mr. A. M. Wellington, Chief Engineer of the New American line of railway between Vera Cruz and the City of Mexico, and engineer in charge of location surveys of the Palmer-Sullivan railroads of Mexico, arrived in New Orleans on the 19th ult., and on the 26th favored us with a call. Mr. Wellington thinks that Mexico is a "land of promise;" it is in a very undeveloped condition at present, but it is bound to become a very rich and prosperous country. The climate, excepting a thin strip on the Gulf Coast, is more than fine; it is perfectly delightful, and very healthy. Living in the City of Mexico is expensive; more so than in this city, but elsewhere in the Republic it is about the same as in the United States. Mr. Wellington will need the services of nearly thirty well qualified civil engineers of all grades inside of the next three months. He left for Cleveland and Chicago on the evening of the 26th, and will leave New Orleans for Mexico on the 16th inst. Mr. Wellington would promise nothing regarding his very popular rule on the "economic location of railways," and the prospects of a new edition for at least a year to come are very poor indeed.

The ruling spirit of the Canada Pacific Railway syndicate is Duncan McIntyre, Esq. Four years ago he was a wholesale dry goods merchant, doing a fairly profitable business in the thriving city of Montreal. A zealous and active partisan in politics on the reform side, he won the personal friendship of Mr. McKenzie, the Canadian Premier, and through his recommendation was induced to join with an experienced railway contractor in completing the extension of the Canada Central Railway from Pembroke to Callender Station, where the connection with the Canada Pacific is to be made. The Canada Central Railway was a bankrupt concern, managed by the great English iron firm, Messrs. Bolckow, Vaughn, & Co., who held nearly all the stock in payment for the equipment of the road. Through his brother Robert, formerly a member of the Canadian Parliament, but now a retired capitalist living in England, Mr. McIntyre bought one million dollars worth of Canada Central stock at twenty-five cents on the dollar, and thus virtually controlled the Eastern terminus of the Canada Pacific Railway by his ownership of the whole of the Canada Central. When the syndicate was formed by Messrs. Stephen, Smith, Angus and Hill, Mr. McIntyre became a necessity. He joined forces with the others and his road was soon merged into the Canada Pacific, of which it is now called the Eastern Division. Mr. McIntyre is probably the most active member of the syndicate, being ever "on the wing," and giving to every detail of the immense interest that he is a partner in his constant and closest attention. He is reputed to have already made a profit of a million of dollars, which probably is not an over-estimate. He is a clear-headed man, of iron will, of untiring energy, of arbitrary methods in business, who has recognized "the tide in men's affairs" that has taken him upon its crest and will bear him onward to a height which only the future can measure.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 469.)

CXLVIII.—PEORIA.

Peoria, Illinois, in lat. 40° 37′ N., long. 89° 42 W., on the west bank of the Illinois River, is on high ground surrounded by bluffs. A trading post was established at this point in 1680 by the French. The permanent settlement began in 1819.

Water-works were built by the city in 1869, taking water from the Illinois River and pumping directly into the mains by Holly rotary pumps. A Cameron pump of 1,750,000 gallons capacity was added shortly afterwards to supply the bluffs. In 1875 a 2,250,000 gallon Dean pump was put in as an auxiliary to the supply. In 1880 two Worthington pumps of 5,000,000 gallons capacity were erected and the Holly engine removed. The pressure is 60 lbs. per square inch for domestic service and 140 lbs. for fire service. Distribution is by cast-iron pipe, of which 43 miles are in use, of from 16 in. to 4 in. diameter, with 267 fire hydrants, 1,645 taps, 6 meters and 7 hydraulic elevators.

The population in 1880 was 29,315 and the daily consumption 2,000,000 gallons.

The works have cost $450,000. The bonded debt is $450,000, bearing from 10 to 6 per cent. interest. The expenditures in 1880 were: For maintenance and repairs, $18,988.73; for extensions, $15,130, and for interest, $32,897.91. The receipts from water rents were $34,805.14. The superintendent of the works reports to the Common Council. T. J. Kelly is the Superintendent and Henry H. Forsyth the City Clerk.

CXLIX.—BLOOMINGTON, ILL.

Bloomington, Illinois, in lat. 40°, 40′ N., long. 89° W., is on an undulating prairie. It was settled in 1831 and incorporated as a city in 1850. Water-works were built by the city in 1875, after the plans of Henry P. M. Birkinbine, C. E., and under the superintendence of Ira Merchant, C. E. Water is taken from a well sunk through soil and clay into water-bearing gravel. The ground where the well was dug is 68 ft. below the highest point in the city. The well is 40 ft. in diameter for 28.5 ft. from the surface, and an 18-in. pipe is sunk 10 ft. more. The water stood in the well the first year, 5 ft. below the surface of the ground.

A Worthington pump of 1,000,000 gallons capacity was erected in 1875, and a Blake pump of

* Copyright 1881.

2,000,000 gallons capacity in 1881. The engines deliver into a 10-in. main leading 1,000 ft. to a stand-pipe of wrought iron, 8 ft. in diameter and 200 ft. high on ground 35 ft. above the engine-house floor. It is inclosed in an octagonal brick tower.

Distribution is by cast-iron pipe of from 10 to 4 in. in diameter, of which 12¼ miles are in use, with 150 fire hydrants, 40 gates and 475 taps.

The population in 1880 was 17,184 and the daily consumption 400,000 gallons. The works have cost $122,000 and the receipts to date have been $27,267. The bonded debt is $75,000 at 8 per cent. interest. The interest is paid out of the city taxes. The expenses in 1880 were $5,426.60, and the receipts $7,613.91. The works are managed by a board of three members of the City Council, with the City Clerk as clerk to the Board. M. X. Chuse, has been the superintendent since the beginning.

CL.—JACKSON, MICH.

Jackson, Michigan, in lat. 42° 15′ N., long. 84° 20′ W., is on both sides of the Grand River. Settled in 1829, it was incorporated as a village in 1843 and as a city in 1857. Water-works were built in 1870 by a private company, and purchased by the city in the following year. The supply is taken from two artesian wells, 6 in. in diameter and 203 ft. deep. Another 10-in. well is now being bored; 1,500,000 gallons have been pumped from the wells in 24 hours.

Water is pumped directly into the mains by Holly pumps. Two rotary pumps were first used. In 1872 two piston pumps of 10 in. diameter and 27-in. stroke were added. A domestic pressure of 50 lbs. per square inch is maintained. The fire pressure is 120 lbs. Distribution is by cast-iron pipe of from 15 to 4-in. diameter. Thirteen miles are in use, with 76 fire hydrants, 35 gates, 182 taps and 4 meters.

The population in 1880 was 16,105, and the daily consumption 800,000 gallons.

The works cost $180,000. The bonded debt is $140,000, bearing interest at 8 per cent., and $23,500 at 10 per cent. The expenditures in 1880, not including interest, were $7,008.90, and the receipts $8,250.92.

Soon after the construction of the works some difficulty was experienced from the freezing of pipes, which had not been laid deep enough.

The works are managed by the Superintendent, John Anderson.

CLI.—RACINE.

Racine, Wisconsin, in lat. 42° 44′ N., long. 87° 47′ W., is on the west shore of Lake Michigan, at the mouth of Root River. The city is on a plateau about 40 ft. above the level of the lake. Settled in 1835, it was incorporated as a city in 1848. About 1870 an artesian well was bored 1,300 ft. by a private company, from which a supply was furnished to one ward of the city. About 1878 another well was bored by the city. The yield of each well is about 550,000 gallons per day.

The distribution was at first by wrought-iron and cement pipe. The distribution of the well owned by the city is by cast-iron pipe, and the company is also substituting cast-iron mains and lead service pipes for the kind at first used. The pipes are of 6-in. and 4-in. diameter. The length of the mains is not furnished.

There are 4 fire hydrants, 5 gates and 200 taps. No meters are used. The entire works have cost $14,000.

The population in 1880 was 16,031. The consumption is not stated. H. Raymond is the Superintendent of the Artesian Well Company.

CLII.—ALLENTOWN.

Allentown, Pennsylvania, in lat. 40° 36′ 24″ N., long. 75° 28′ 34″ W., is on high ground on the west bank of the Lehigh River, between the Little Lehigh on the north and Jordan Creek on the south. The streets leading into the city from the three rivers are all of steep gradients.

The town was settled in 1762, incorporated as a borough on March 18, 1811, and as a city on March 12, 1867.

The Northampton Water Company was incorporated in 1816, for the purpose of supplying water; but no active steps were taken towards that end until 1827. In 1833 the property of the company was valued at $18,000. Water was taken from Worman's Springs, which yield 2,500,000 gallons per day. The company was reorganized some years later as the Allentown Water Company, and in 1865 the works were purchased by the city for $140,000.

A timber dam 6 ft. high across the Lehigh River gives a water power, which drives two turbine wheels, which work piston pumps, forcing the water, which is brought from the spring, through 2,300 ft. of 12-in. pipe to the pump well into a stand-pipe 6 ft. in diameter and 55 ft high, and two covered reservoirs, one 48 by 29 ft. and 13 ft. deep, the other 96 by 32 ft. and 12 ft. deep, holding 410,242 gallons.

Distribution is by cast-iron pipe of from 16-in. to 2-in. diameter, of which 18 miles are in use, with 95 fire hydrants, 2,400 taps and 18 meters. During the summers of 1879 and 1880 low water in the river caused serious apprehensions and some deficiency in the supply on account of lack of pumping power.

The population in 1880 was 18,063 and the daily consumption 1,000,000 gallons.

The works have cost $189,054.76. The bonded debt is $135,622. The first bonds bore 7 per cent. interest. Those of this issue, falling due in 1879–1880, were refunded at 6 and 5 per cent interest.

The receipts and expenses since 1875 (except 1878, which are not furnished), have been as follows:

	1876.	1877.	1879.	1880.
Expended for interest.....	$9,589.53	$9,642.74	$8,823.01	$11,259.99
Expended for maintenance, etc.....	5,777.96	2,905.38	5,986.33	3,403.68
Receipts.....	20,202.96	16,804.08	15,486 30	16,438.75

The works are managed by a board of four water commissioners appointed by the councils.

Russell A. Thayer was superintendent to 1879. Samuel S. Thompson is the present superintendent.

(TO BE CONTINUED.)

The receipt of statistics, as follows, is acknowledged with thanks. From Samuel W. Waddle, City Clerk, statistics and water rates of Bloomington, Ill., Water-works. From John Anderson, Superintendent, statistics and water rates of Jackson, Mich., Water-works. From H. Raymond, Superintendent, statistics of Racine, Wis., Artesian Well Company. From W. O. Munson, Secretary, reports of Trustees of Zanesville, O., Water-works for 1874-'5-'6-'7-'9-'80. From H. H. Forsyth, City Clerk, statistics of Peoria, Ill., Water-works, and reports of city officers for 1871 and 1880. From J. Nelson Tubbs, Chief Engineer, report of Rochester, N. Y., Executive Board, April, 1881. From Frank Doherty, Superintendent, report of Trustees of Columbus, O., Water-works, March 31, 1881. From Samuel S. Thompson, Superintendent, statistics of Allentown, Penna., Water-works and reports for 1876-'7-'9-'80.

Speaking of the enlarged Welland Canal, the *St. Catharines Journal* says: "So complicated is the machinery of the locks that it is thought unsafe to go through except under the immediate supervision of an experienced engineer. Outsiders and vessel men are not able to elucidate the mysteries connected with the enlarged Welland Canal, through which vessels are only allowed to pass, it seems, by special favor. Only two vessels have been permitted to lock up and one down, so far. Practically the canal is not yet open for a twelve-foot navigation. When it will be seems to be known only to the chief engineer. The scheme of canal enlargement cannot be fully realized until the aqueduct at Welland is built, a work not even under contract, although it is one which will require two or three years to complete."

CORRESPONDENCE.

TOTAL CURVATURE OF ANY LENGTH OF CURVE.

CAMP DEEP CREEK, Nev., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I notice in your issue of Oct. 15 Mr. Hollingsworth's article regarding method of ascertaining total curvature for any length of curve. I suppose that Mr. Hollingsworth's idea is that you are to cut his table of multipliers out and paste it in your hat.

I give you the following method as being, in my judgment, very much simpler: Divide the total number of minutes in the index degree by 100, which gives the curvature for one foot; then multiply this quotient by the number of feet in the curve and you have the total curvature expressed in minutes. For example, to find total curvature of a 3° 20′ curve of 1,279 ft. length: 3° 20′ = 200′ ÷ 100 = 2′ × 1,279 = 2,558′ ÷ 60 = 42° 38′ = total curvature.

F. C. HAND.

THE DISEASE OF NEW YORK AND ITS REMEDY.

NEWPORT, R. I., Nov. 19, 1881.

EDITOR ENGINEERING NEWS:

I have carefully read your editorial review of my letter of Nov. 15, and beg space for a reply.

Let me first state that I have not so much objected against the views entertained by "W." in his communication, "The Disease of New York and its Remedy," as against the tone of the article. As a constant reader of ENGINEERING NEWS, I would have much preferred to find in its columns an impartial criticism on the "separate system of sewerage." The article of "W." may do very well for a daily paper, but personal controversies do not, in my opinion, belong to the columns of an engineering journal.

As I understand the article of "W.," it condemns the principle of the system proposed for the city of New York by the writer of the *Scribner* article. And just here I dissent from his views. While I do not believe that the separate system is adapted for New York City, nor that one method of removing human excreta, etc., from inhabited localities can be applied with equal success to all cases; and furthermore, while I do not think that the existing condition of the sewers of New York is "unavoidable in all works of combined sewerage," I do believe that there are many instances in which the separate system may be adopted with advantage.

Reference to the *Sanitary Engineer*, vol. 3, p. 379, will show that my opinion in regard to sewers of both systems was expressed as follows: "Both may be so planned and constructed as to insure the instant removal of all liquid and solid excreta with sufficient velocity to prevent deposits (in either case, if necessary, flushing arrangements may be provided)." I see no reason for deviating from my opinion now. As an instance of a successful system of "combined" sewerage I would cite the sewers of Franfort-on-Main, designed and built by William Lindley, Esq., C. E., which are pronounced, by all who have carefully examined them, model sewers in every respect, and probably as free from sewer gas as the sewers of Memphis are said to be.

But when you say "that the intelligent engineer who advocates the separate system for populous cities lays himself open at least to suspicion as to his motives, in view of the present condition of the sewerage question in this country," I beg to differ from your opinion. Mr. C. H. Latrobe, C. E., who in his recent report upon the sewerage of Baltimore recommends the separate system for that certainly "populous" city, could have no other motive in advocating the system than the desire to benefit the citizens of Baltimore with his

experience and views on the subject, to which he devoted a long and thorough study.

I am willing to admit that Mr. Latrobe's view, as quoted by you, that the city will derive a considerable revenue from utilizing its sewage, may be too sanguine, as present experience does not seem to justify the expectation of much profit from sewage utilization.

But it would seem to me to be equally wrong to condemn entirely, on this account, the purification of sewage by irrigation or similar methods. I think that there are many cases, not only in the old country, but also in the United States, where cities should carry out sewage purification works, even if they would realize no profit whatever from them. The loss from running these works should simply be charged to city expenditures in the interest of the public health. There are, in my opinion, cases where cities must adopt some method of purification in order to keep their rivers pure, such as, for instance, Milwaukee, Paterson, Newark, Worcester, etc.

In all these instances, but especially so where pumping must be resorted to, the separate system is, I think, entitled to great consideration.

When I said that the separate system of sewerage was first introduced into this country by the writer of the *Scribner* article, I did not intend to convey the idea that the engineering profession had hitherto no knowledge of such a system. I only meant that he was the first to carry out sewerage works according to that plan in a city of the United States. If you can name me any other city where sewers for house refuse only were built previous to those at Memphis, I shall certainly acknowledge my mistake.

I note the report of the Committee on the Metropolis (London). But I fail to see why, if in 1856 the separate system was condemned as impracticable for a metropolis, it should follow that it is equally inapplicable to other cities not as populous as London. As a matter of fact, since 1856 a number of opinions, entitled to the highest consideration, have been very favorable to the separate system.

Your remark about the works and writings of the author of the *Scribner* article I disregard entirely. I, for one, certainly differ from your opinion in this respect.

I admit that, as a general rule, the plumber's work ranks with that of a handy craftsman, and that the occupation of plumbing should not be called a "profession." This was merely a *lapsus calami*; it does not, however, in the least affect what I have said about plumbers and their work.

Referring to your illustration of the needless alarm kept up about the filthiness of the pan-closet, I will say that, to my knowledge, every sanitary engineer, whose experience through examination of the sanitary condition of city dwellings has led him to give the subject of water-closets careful onsideration, agrees with the writer of the *Scribner* article about the utter worthlessness of the "pan-closet." I am fully aware that its most glaring defects can be modified by special devices, such as a fresh air pipe and a vent pipe to the container, flushing arrangement for pan and container, etc. But I hope that you will agree with me that, with the amount of extra expense necessary to make the pan-closet fairly acceptable, a better water-closet can be bought.

My opinion about the unfitness of the pan-closet is not at all changed by the fact that 600,000 persons in New York use no other, nor do I believe that one person in a thousand in that city has informed himself about the usual condition of the hidden parts of the closet. But those few that have given the matter consideration acknowledge its defects, and begin to ask for improved devices. Whoever can afford to pay for a better substitute will never use the pan closet. Its cheapness is its only merit, and this is the only reason why it is so largely used. Space does not permit me to give in full the opinions of sanitary engineers about the pan-closet.

I will briefly quote from Mr. Philbrick's "American Sanitary Engineering," page 118: "Though so popular and almost universally used in this country, *the pan-closet is a very defective one, and often becomes a great nuisance in houses* (the italics are mine).

Mr. Jas. C. Bayles says in "House Drainage and Water Service:" "Closets of this pattern are defective in principle and unsatisfactory in operation; and although they have been variously modified and improved during the past years, it is doubtful if they are susceptible of such improvements as will wholly correct their inherent defects."

Mr. Hellyer, a practical plumber and manufacturer of plumbing goods, says in his "Plumber and Sanitary Houses:" "The writer has always been puzzled to understand how this apparatus has become so great a favorite with the public and been to extensively used by the craft. The only bliss that the public can have about so foul a thing is 'ignorance' of its nature, but what excuse to make for the plumber I know not, except that it was the custom of their fathers to fix a pan-closet and this has become a law with them."

Your illustration, showing the higher salubrity of a city house with a pan-closet, as compared with life in a country village, without sewers or modern conveniences in the houses, is, I believe, not well taken. There are other and certainly just as serious defects in a country village without sewerage, which may account for the appearance of zymotic diseases; for instance, the almost universal leaching privy vault in close proximity to shallow wells, from which the water supply is taken, and that to these a large amount of *preventable* sickness in the country is due, nobody will deny who has read the numerous Board of Health reports.

Thanking you for the privilege offered me of space in your columns for a reply,

I am yours, very respectfully,

WM. PAUL GERHARD.
Civil and Sanitary Engineer.

[We gladly give place to the above well-written article.

Admit that "W.'s" article would appear better in a daily paper.

Are pleased to find agreement between us as to the inapplicability of *one* system to all circumstances and localities.

Regret that Mr. G. should see in a remark bearing upon the possible motive of "intelligent" engineers reference solely to *pecuniary* motives. The Temple of Ephesus, we are told, was burned by a worthy who sought by that means "immortality."

Agree with him substantially in what he says as to irrigation works and pumping sewage. He is correct, we believe, as to the city of Memphis being the first *city* to introduce separate sewers.

He is equally sound as to the principle of the pan-closet not being the *best* in the market, possibly, but is in error when he assumes that a reasonably economical machine, such as only the masses can afford, can be devised, which will not in use become open to objections from a "theoretical" sanitarian

We recognize Mr. Philbrick as good authority on this subject, as also Mr. Bayles to a certain extent, but we hesitate to accept on general principles the opinion of "any manufacture of "plumbing goods," on such a subject as the selection of a proper closet. Mr. G. is also correct in his general views as to the possible prevalence of preventable disease, and the causes which may lead to it in country places; but we may fairly conclude that this pan machine is not so very deadly as reported, if immunity from disease, after long years of its use in the city, should prove more clearly marked than when the surroundings were those of a country home, and which, so far as human sagacity could be a guide, was free from the influence of any of these sources of contamination, mechanical or otherwise, likely to appear in country places. —ED. ENG. NEWS.]

PLANS FOR THE NEW TAY BRIDGE.

The plans of the proposed new Tay bridge, prepared by Mr. W. H. Barlow, C. E., are now on exhibition in Edinburgh, for inspection by intending contractors. The new bridge, says the London *Times*, which is to be built on the girder principle, will commence on the south side, about 16 ft. west of the former bridge. At this end four brick arches are shown next the shore, each having a span of 50 ft. The girder work then commences with a span of 118 ft. from center to center of the piers, and is continued with 10 spans of 129 ft., and 13 of 145 ft. from center to center of the piers, until navigable portions of the channel are reached. Here there are 13 wider spans, 11 being each 245 ft. and two 227 ft. each. Of these spans the first four are carried to the greatest height of the structure, and give 77 ft. of clear headway above high-water mark. From this point the line of the bridge commences to fall toward the north or Dundee side, at a gradient of one in 114, there being one span of 162 ft., ten of 129 ft. 6 in., and one of 127 ft. 6 in. These spans carry the bridge on to the commencement of the curve toward Dundee, and 25 more, each of 71 ft., take the structure to the side of the proposed extension of the esplanade. Several other spans take the bridge on to the point where it is run into the level of the existing arches. The bridge is to be constructed for a double line of rails throughout.

The foundations in the river bed will be formed of two wrought-iron cylinders placed at a distance of 26 ft. apart from center to center, and filled with concrete. These cylinders rise to the height of within 2 ft. of low-water mark, where brick will be used, filled in also with concrete. The brick-work is to the height of 8 ft. above high-water mark, at which level the cylinders are connected and made to form a solid foundation, topped with a course of ashlar. Rising from this foundation two piers are formed of wrought-iron pillars braced together and incased with iron plates of from $\frac{3}{8}$ to $\frac{7}{8}$ in. in thickness. The piers thus constructed are connected with each other near the top, and the whole has the appearance of a high and strongly built arch on which to place the girders. The principal piers are octagonal in shape, with a diameter varying from 11 ft. to 14 ft. 6 in. The spans are each composed of four girders, with the exception of the higher spans. These are two girders connected together, top and bottom, with bracing and flooring. The bridge throughout its whole length will have a parapet of between 5 ft. and 6 ft. in height, forming a wind guard. The depth of each girder on the piers is 16 ft. 6 in The middle girders are 28 ft. 9 in. in the center and at the ends 20 ft. 3 in. They are of hog-back lattice form. The other girders are of plain lattice work, and are all connected by cross-bracing, on the top of which the train travels, as it did on the old bridge. At the high girders the train travels between them. The platform of the bridge is of wrought iron throughout. In the construction of the new bridge, the old one will be sufficiently near for anchorage and cranes.

THE MISSISSIPPI AND TRIBUTARIES.

A pamphlet on the Mississippi and its tributaries gives the following statement of the mileage of the navigable portion of each of the following-named rivers above its mouth; Missouri, 3,120; Mississippi, 2.161; Ohio, 1,021; Red, 987; Arkansas, 884; White, 779; Tennessee, 789; Cumberland, 900; Yellowstone, 474; Ouachita, 384; Wabash, 365; Alleghany, 325; Osage, 363; Minnesota, 295; Sunflower, 271; Illinois, 270; Yazoo, 226; Black (Arkansas), 112; Green, 200; St. Francis, 180; Tallahatchie, 175; Wisconsin, 160; Deer Creek, 116; Tensas, 112; Monongahela, 110; Kentucky, 105; Bartholomew, 100; Kanawah, 94; Muskingum, 94; Chippewa, 90; Iowa, 80; Big Hatchie, 75; St. Croix, 65; Rock, 65; Black (Louisiana), 61; Macon, 80; Bœuf, 53; Big Horn, 50; Clinton, 50; Little Red, 49; Big Cyprus and lake, 44; Big Black, 35; Dauchitte, 33. Total number of rivers, 33; total number of miles of navigation at present, 15 710.

ON FIRE-HYDRANTS, WITH DESCRIPTION OF ONE IN USE AT HALIFAX, N. S.*

BY EDWARD HENRY KEATING, CITY ENGINEER, MEM. INST. CIVIL ENGINEERS.

The most simple form of hydrant is a stand-pipe with one or more hose-couplings at the top, and a water-valve at or near the base. If the valve is so arranged that, in the act of closing it, a waste-valve is opened, by which the stand-pipe will be drained or emptied of water, the apparatus in be at once got at and controlled by the firemen, without the necessity of searching either for its position, or for that of the valve by which it is regulated.

In design the chief matters needing attention are:

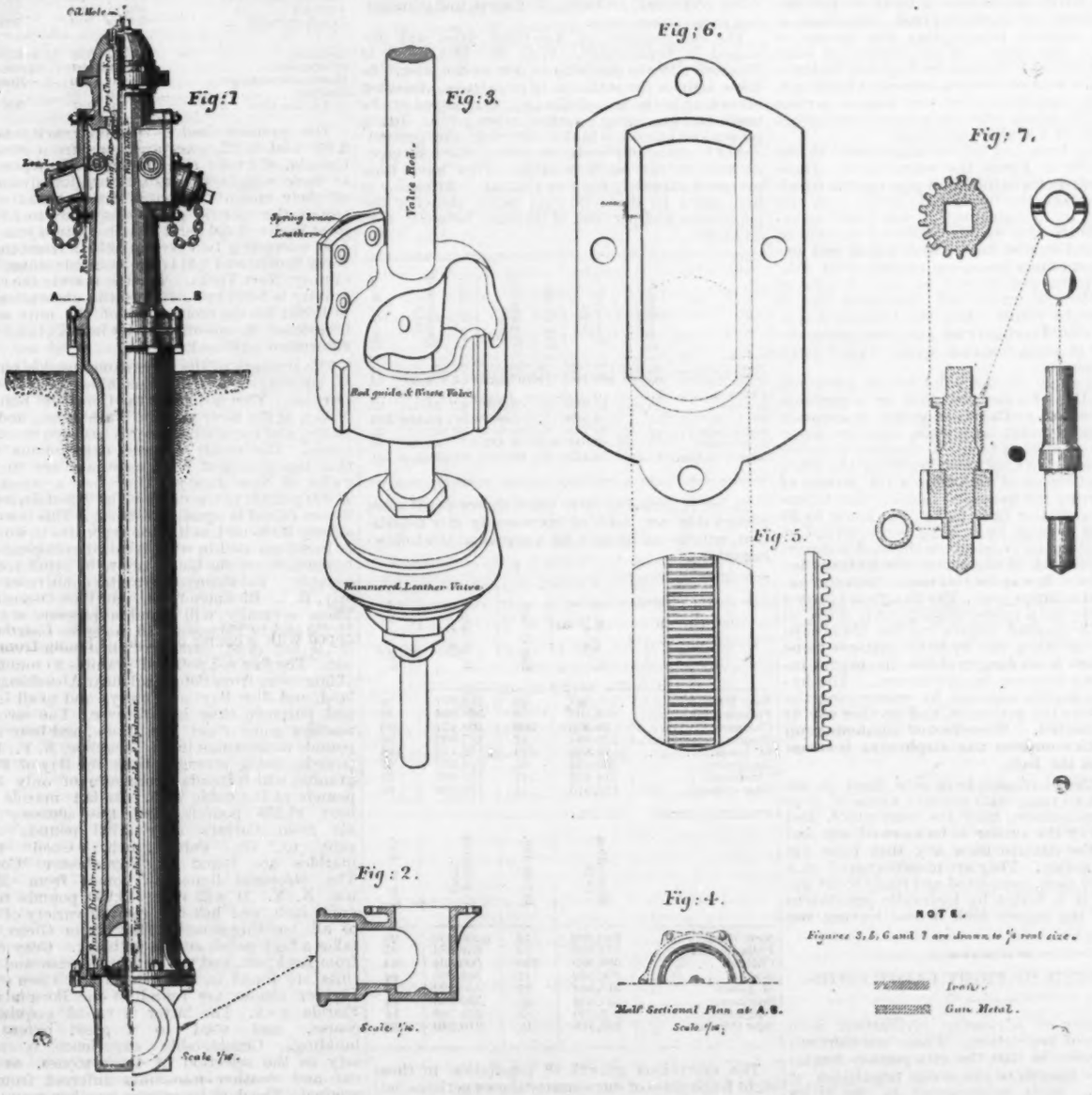
1. Simplicity as far as practicable.

2. That all the different parts be durable, not liable to derangement, and strong enough to withstand rough usage at the hands of inexperienced, careless or excited men.

ground for a few weeks at a time; while after the periodical changes from wet to dry and cold, the whole surface of the country is occasionally covered with a glaze of ice. Frost penetrates the ground to a depth of from 3 to 4 ft., and in clay soils to about 5 ft.

The water mains as a rule are laid at a depth of 5 ft. from the surface of the street to the top of the pipe.

There are about 300 hydrants in the city, at distances apart varying from 250 to 450 ft., the usual interval being 300 ft. Most of these hydrants are



NEW FIRE HYDRANT, ADOPTED IN HALIFAX, NOVA SCOTIA.

many situations will probably answer the purpose as well as some of the more costly appliances.

There are, however, some objections to this form of hydrant, especially in climates subject to frost and snow. If the locality is one where the thermometer at times falls many degrees below freezing point, and deep snow lies upon the ground for days or weeks together, the inconvenience and delay caused by the necessity of measuring to ascertain the position of the valve, and in digging through snow or ice to reach it, may be great; while during the time that these operations are being performed a conflagration may gain serious headway.

In such localities it becomes of the first importance to adopt some form of hydrant that can

3. That it may be relied upon during frost without the necessity of frequent inspection.

4. That the stand-pipe and valves be so proportioned as not to affect the free delivery of water at the nozzles.

5. That it may be easily removed for repairs or replaced.

6. Perfect drainage.

At Halifax during winter the maximum thermometer ranges between + 40° and + 60°, and the minimum thermometer between + 20° and — 10° Fahrenheit; although at intervals of several years the thermometer has been known to fall as low as — 20°. The climate, being affected by the Atlantic and oceanic currents, is moist and changeable. Usually there are periods during which the atmosphere is clear and bracing, succeeded by a few days of rain, and sometimes fog. Snow sufficient to allow good sleighing often remains upon the

of an old style, set in a brick well or chamber built for their reception below the foot-path adjoining the curb. In outward appearance they resemble in some respects Fig. 1, with the casing or frost jacket removed, but are dissimilar in detail and construction. The chamber is covered by a cast-iron plate provided with a hatch, by which access is gained to the bottom of the hydrant where it joins the branch from the main. This arrangement, although possessing some advantages and admitting of the easy removal of the hydrant, was considered by the author objectionable for several reasons, principally on account of the difficulty and expense in keeping the valves free from ice, and the large iron sidewalk plate becoming smooth and dangerous.

From four to five men were constantly employed throughout the winter, whose daily duty it was to examine each hydrant, thaw out the ice from an

*From minutes of Proceedings of the Institution of Civil Engineers, Session 1879-80.

which should be found frozen up, and to see that they were in proper working condition.

The hydrant, Fig. 1, was designed and adopted by the author after a careful inspection of many others, and after consultation with practical men connected with the fire departments of Halifax and other Canadian cities. It is not claimed that all the details are original. The main valve and the rod-guide, which also forms the waste valve, Fig. 8, are the same as in an American hydrant known as "the Matthews hydrant," and the gate, or cut-off valve, at each nozzle (Figs. 5, 6 and 7) is partly the invention of a local mechanic. The object of the latter contrivance is to allow the hose to be coupled to, or uncoupled from, one nozzle at any time, without interrupting the stream of water from the other. In the absence of some such arrangement it frequently happens during a conflagration that only one nozzle can be utilized, and, in the experience of the author, serious troubles have arisen between different authorities for the want of a similar provision.

The spring brass and leather attachment to the rod-guide (Fig. 3) forms the waste valve. There are two waste-holes in the stand-pipe against which this valve works, the upper hole being ½ in. and the lower ⅝ in. in diameter. It was found necessary to provide this double waste on account of the lower and smaller hole, which was at first the only one, sometimes becoming choked with sediment, and it was not thought advisable to enlarge it, as considerable waste and consequent loss of pressure might result while the hydrant was in use. This would certainly be the case unless the main valve in each instance were screwed down to its full extent.

The main screw on the valve-rod is protected from the action of water and frost by a partition and stuffing-box. The frost-jacket is securely bolted to the iron seat, and when once set never need be removed. It forms a dead-air chamber which prevents the frost from reaching the main valve, and at the same time affords the means of easily removing the hydrant. Some hydrants provided with a similar frost-jacket are made to fit tightly upon the seat by a large screw turned at the base; but in the event of the slightest derangement to the thread of the screw the hydrant becomes useless. It was for this reason that the author adopted a flange joint. The flanges are turned perfectly true and a rubber diaphragm is made to fit into a dove-tailed groove on the stand-pipe flange, so that when the hydrant requires to be taken up there is no danger of the diaphragm remaining down to cause inconvenience. The hydrant can be readily removed by unscrewing the nuts just above the pavement, and another can as readily be inserted. The effect of tightening up the nuts is to compress the diaphragm between the flanges at the base.

Many of these hydrants have now been in use for the last two years with scarcely a case of stoppage or derangement; they are frost proof, and are believed by the author to be more reliable and suitable to the climate than any that have yet come to his notice. They are manufactured at a cost of $66.50 each, completed and ready to set up. Each hydrant is tested by hydraulic pressure to 200 lbs. on the square inch before leaving the workshop.

THE GROWTH OF EIGHT LARGE CITIES.

The tendency of advancing civilization is to dense centers of population. From one-thirtieth of our population in 1790, the city portion has increased to one-quarter of the entire population of the country. Such inducements as our cities afford prove too attractive for the rural population. The strong lights and shadows of our cities, the love of society, the satisfaction of better shelter, better roads, stronger institutions, lead men to crowd together even when unable to be anything but dependents in the system to which they unite themselves. Great enterprises demand massed effort; the individual often sinks his own will, his own property, his own happiness, present and prospective, in the tenement house of the city, when he might have been an independent man with a fair competence had he been contented with a rural life. The pre-eminent success of a few in the vast commercial enterprise, in manufactures, in public affairs, tempts those living in the rural districts to the centers of energy, and hope keeps them there till many of them cannot get away.

Dr. J. H. Bridges, in an address delivered before the National Health Association of London, made the statement that six out of each eleven persons living in London were born outside of it. The same holds true to even a greater extent in the large cities of the United States. Dr. Bridges claims that as a usual thing these people do not regret having left the country village. There is no homesickness. Why? Because village life is dull; because in London, with its vile lodgings and precarious struggle for existence, there is excitement, there is life by the brain. There is a rich multiform drama every Saturday night in the Whitechapel road—flaring gas light, strong lights and shadows, carts of vegetables and cheap fruits, variety of strongly-seasoned food, toys, colors, shop-windows, street cries, collisions, medleys, of all sorts, and stimulating social intercourse.

The development of American cities was discussed in Bradstreet's, April 30, 1881, and of Western cities in particular a few weeks later. In these articles the statistics of population, classified according to the size of the city, as reported by the tenth and preceding censuses, were given. In the present article some tables showing the percentage of increase in population during the last eight decades in our eight principal cities have been prepared expressly for this journal. Attention is first called to the following table, showing the population and per cent. of increase between 1810 and 1840:

	Population 1810.	Population 1820.	Per ct. inc.	Population 1830.	Per ct. inc.	Population 1840.	Per ct. inc.
New York	96,377	123,706	28	203,007	63	312,710	54
Philadelphia	96,691	108,116	12	167,188	54	258,037	54
Chicago						4,479	
Boston	32,250	43,298	34	61,392	42	93,383	52
St. Louis		4,598		5,852	27	16,469	181
Baltimore	46,555	62,738	35	80,625	29	102,313	27
Cincinnati	2,540	9,644	279	24,831	157	46,338	87
New Orleans	17,219	27,107	57	46,310	70	102,193	121

The next period of forty years shows a still more remarkable per cent. of increase in city population, which can be seen by a glance at the following table:

	Population. 1840.	Per ct. inc.	Population. 1880.	Per ct. inc.
New York	515,507	65	814,277	58
Philadelphia	408,762	58	568,034	36
Chicago	29,963	569	109,424	285
Boston	136,881	47	177,902	30
St. Louis	77,860	373	162,179	108
Baltimore	169,954	65	214,047	27
Cincinnati	114,436	147	160,060	39
New Orleans	116,375	14	170,786	46

	Population 1870.	Per ct. inc.	Population 1880.	Per ct. inc.
New York	942,292	16	1,206,590	28
Philadelphia	674,022	19	846,984	25
Chicago	306,605	180	503,304	64
Boston	250,526	41	362,835	44
St. Louis	310,864	91	350,522	13
Baltimore	267,354	25	332,190	24
Cincinnati	216,239	35	255,708	14
New Orleans	191,418	12	216,140	13

The marvelous growth of population in these eight large cities of our country shows perhaps better than anything else the great expansion of human settlements and of material civilization which are the most striking features of the memorable epoch in the history of the United States which began with the discovery of gold thirty years ago.

STRENGTH OF BUILDING-STONES.

The recent conflagration in this city, causing the destruction of a so-called fire-proof building (Morrell's warehouse), calls attention to the subject of the durability of building-stones in general. Dr. Hiram A. Cutting, of Vermont, has made some valuable and interesting experiments to determine the amount of heat the various building-stones in use will stand, and has extended his experiments to twenty-two kinds of granite, twenty-three of sandstone, seven of limestone, seven of marble, three of conglomerate, one of slate, one of soap stone and one of artificial stone. Under the application of the heat the granite (1) began to yield at a temperature between 700° and 800° F., (2) became cracked between 800° and 900° F., (3) became generally cracked between 800° and 950° F., and (4) was made worthless by or before reaching a temperature of 1,000° F.

The following table contains these results, and those also for the other kind of stones, the stages of destruction being indicated by the inclosed numbers:

	Degrees. (1.)	Degrees. (2.)
Granites	700 to 800	800 to 900
Sandstones	800 to 900	850 to 1,000
Massive limestones	850 to 950	900 to 1,000
Marbles	900 to 1,000	950 to 1,000
Conglomerates	600 to 700	700 to 800
	(3.)	(4.)
Granites	800 to 950	At or below 1,000
Sandstones	900 to 1,000	1,000 to 1,200
Massive limestones	900 to 1,100	Mostly 1,200
Marbles	1,000 to 1,200	1,200
Conglomerates	800 to 900	900 to 1,000

The granites had a specific gravity between 2.600 and 2.727, excepting one from Stanstead, Canada, of 2.833; and immersion in water added to their weight, through absorption, from 1-280 of their weight to 1-818. In the case of sandstones, the specific gravity is 2.168 to 2.661, but most under 2.400; and the absorption was 1-17 to 1-80, excepting two giving 1-240 (a freestone from Nova Scotia) and 1-314 (the Montrose stone, Ulster County, New York). For the marble the specific gravity is 2.666 to 2.848, and the absorption 1-300 to 1-380; for the more solid of the pure massive limestones the specific gravity is 2.478 to 2.706, and absorption 1-280 to 1-480.

The strength of the large stones used in our public buildings is tested by machines made for the purpose. This is done at the Columbia School of Mines, at the navy yard in Washington, and other places, and every stone known has been thoroughly tested. The result of these experiments shows that the strongest building-stones are the trap rocks of New Jersey. They bear a pressure of 24,000 pounds to the cubic inch. The dolerite from Staten Island is equally as strong. This is comparatively little used, as it is too expensive to work, but is, however, used in what is called cyclopean architecture, where the blocks are to be fitted together roughly. The strongest granites come from Westerly, R. I.; Richmond, Va., and Port Deposit, Md. These severally will stand a pressure of 17,750, 21,250 and 19,750 pounds to the cubic inch. Granite is the most durable of all stone in every-day use. The fine red polished granites so much used of late come from Peterhead, near Aberdeen, Scotland, and the Bay of Fundy, and to all intents and purposes they last forever. The strongest marbles come from Lee, Mass., and bear 13,440 pounds to the cubic inch; Tuckahoe, N. Y., 12,950 pounds, being stronger than the Bay of Fundy granite, which stands a pressure of only 11,812 pounds to the cubic inch. Italian marble will bear 11,350 pounds, and the statuary marble from Carrara only 9,723 pounds pressure to the cubic inch. Good rough marbles are found in Westchester County. The strongest limestone comes from Kingston, N. Y. It will resist 13,900 pounds to the cubic inch, and has the greatest variety of color of all building-stones. That from Glens Falls takes a high polish and is jet black. Gray comes from Lockport, and the delicate cream and dove tints are found in the Athens and Caen stones. Lighter shades are found in the Bermuda and Florida rock. The latter is called coquina, is coarse, and used to a great extent in building. Considerable experience is necessary in the selection of these stones, as they cut and weather into tints different from the original. The dark limestones weather gray oftentimes by the oxidation of the coloring matter.

The gray Lockport stone when dressed by the hammer resembles a light granite, and is consequently used for trimming brick houses. The cream-colored limestone of the Paris basin is very soft at first, and would be esteemed by a green hand unfit for any purpose, but it hardens when dressed, and the most delicate work can be done, the exposure that would chip the work in other stones being its preservative. The Topeka stone, now much used from Kansas, possesses the same valuable property. It can be sawed like wood in any shape. The limestones that are most valued, however, in this country, come from Dayton, Ohio; they are greatly used by Cincinnati builders. In Chicago the favorite limestone is the Athens, before mentioned, from Northern Illinois. These were deposited by the great seas of the Niagara period of geology.

The lighter stones come from the Ohio, and belong to the lower carboniferous. A medium between the two in color comes from Amherst,

Both are excellent as resisting fire. Many of the finest buildings in Cincinnati are built of the Waverley sandstone of a light dove color. Other rich stones are the St. Genevieve from Missouri, straw-colored and finely grained. All these stones will stand a greater pressure than is ever demanded of them, 50,000 pounds to the square foot being, perhaps, the maximum. The pillars of All Saints' Church at Angiers sustain a pressure of 86,000 pounds to the square foot, and the columns of the Pantheon 60,000 pounds.

LIVERPOOL ENGINEERING SOCIETY.

The twelfth meeting of the session was held on Wednesday evening at the Royal Institution, Colquitt street, at 8 o'clock, Mr. A. J. Maginnis, Vice-president, in the chair. A paper on "Tides and Tidal Scour" by Joseph Boult, Esq., was read by the author. In the first part, the author pointed out that the equilibrium theory of the genesis of tides had been found unsatisfactory by Dr. Whewell, Sir W. Thomson, and other investigators. That theory assumes the generation of a great tidal wave in the Indian Ocean, which travelling westward produced the phenomena of tida-action upon each coast in its progress. It was suggested this assumption involved the idea of spasmodic action, which, if it existed, would propagate concentrical waves, like the ripples produced by dropping a stone into smooth water. It was also suggested that, as the lunar and solar attraction and the earth's gravity acted in opposite directions—particles on the earth's surface being drawn toward its center and toward the moon and sun—the amount of free centrifugal force would vary with the relative position of sun, moon and earth; its greatest development being when the sun and moon were in conjunction or in opposition, at which relations tidal action is greatest. Thus the genesis of tides, instead of being spasmodic and wave-like, is continuous, acting upon each meridian in turn. It was further suggested that anomalous tidal action may arise from two causes. 1st. From the greater development of centrifugal force at the equator, where the velocity of the earth's surface is greatest, than towards the poles, where that velocity gradually disappears, the poles being stationary. 2d. From the tendency of the equatorial excess to pass off towards the poles. A third cause is to be found in obstructions arising from the configuration of the earth adjacent to tidal water, which produces retardation. That the force so diverted found in the Arctic and Antarctic frozen seas, accumulating chambers, in which the parts arriving from the Atlantic and Pacific were combined, and escaping, returned towards the equator, on the line of least resistance. Thus might be explained the fact by which Whewell was so perplexed, viz., that in the North Atlantic the tides on the west coast of Europe are subsequent to or later than those of the same age on the east coast of America. In the second part attention is drawn to the great improvements which have been accomplished in the harbors of Dublin, Glasgow, Perth, Preston and the Tyne through the removal of obstructions to the passage of tidal force. The treatment had varied with local conditions, but the general principle was to reduce the bed of the river to a gentle slope at a considerable depth, and to increase or diminish the breadth of the channel. Thus the velocity of flood had been rendered more uniform, and on the whole increased, and more time secured for the discharge of the upland waters at a more uniform rate, upland water being the most efficient natural agent for deepening and maintaining the channel. Most of the improvement referred to was, however, to be ascribed to continual dredging, including in that term every artificial method by which those channels were deepened and widened; and dredging was essential to the maintenance of the channels, notwithstanding the invaluable assistance given by tidal force. The vice-president announced that the author would read the second part of his paper at the next meeting of the Society, which would be held on the 23d inst., when a discussion would take place on the subject of the paper. The paper was illustrated by numerous diagrams.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

Appleton, Wis., has decided on water-works.

Water is supplied to the houses in Pullman, Ill., from the Hyde Park water-works.

Fort Dodge, Ia., has accepted the water-works just finished at that place.

Five Wells have been sunk at Bliswille to increase Long Island City's water supply. They are expected to yield 2,000,000 gallons a day. The present supply is 1,500,000.

Litigation begun in Vincennes, Ind., is likely to prevent the water-works company from laying its mains, on the ground that the city debt has reached its limit, and no new bonds can be issued.

The Daniel Shaw Lumber Company, for a considerable period, used its influence to have some extent to a system of water-works created by the city of Eau Claire, Wis. Failing in that end, the company determined to establish water-works of its own.

The Owego Water-Works Company, of Owego, N. Y., have just put in a large new Dean pump with condensing attachment, for the purpose of supplying the village in case of failure of the reservoir. Cost, about $1,000.

The flooded coal mine at Streator is estimated to contain 300,000,000 barrels of water, and the present pumping facilities will require 450 days to remove it. It is proposed, however, to cut a tunnel from Vermillion River to the mine, which would soon drain it.

The New Haven Water Company is considering a proposed new contract with the city. Gov. English said, at a recent conference, that the company's stock is too high at 80, and he thinks the company should spend at least $500,000 in improving the works, which have been neglected because of the uncertainty of the city's action. A new source of supply and larger mains are needed.

The engineer employed by the city of Lincoln, Neb., to examine the practicability of large wells to supply the city with water, reports that a well 50 ft. in diameter by 60 in depth, to cost between $5 000 and $10,000, would afford ample supply for all purposes. The engineer estimates that the entire cost of water-works, including 12 miles of main, at from $94,000 to $100,000.

A green substance, supposed to be the same as the fresh water sponge described by Prof. Remsen as being the cause of the foul odor and taste of the Boston water, is known to have existed in the Hartford water supply, and masses of it have been found growing in the pipes and adhering so closely that they could not be pulled off, though they could be scraped away. It remains to be seen if this is the true and only cause of the present trouble, and if it is, it is hard to see how the flushing can wholly cure the evil, since what cannot be pulled off will hardly wash away under the pressure of any current that can be produced. Any matter sufficiently disorganized to have lost its hold on the pipe can of course be removed in this way, and thus an improvement can be made, even if the trouble is not wholly eradicated.—*Hartford Post.*

FRESH-WATER SPONGES.—In the course of an interview with a Boston *Advertiser* reporter, Prof. Hyatt, while considering the subject of fresh-water sponge, the supposed cause of the bad taste and odor in the Boston water supply, said: "Fresh-water sponges are found in the ponds of New England and as far north as Canada. They are an annual product of growth, and flourish in this region during the summer months and somewhat late in the fall, but perish, and their substance decays as the cold weather comes on. Contrary to the opinion formerly held by writers on natural history, the sponge belongs to the class of animal life The explanation of the non-discovery of these sponges in examinations made on former occasions when the water supplied to the city had been bad, is doubtless in the circumstance that the examinations were made after disintegration and decomposition had taken place. The annual growth is maintained by the deposit of seed bodies, which remain in the water or upon the bottom during the cold season. The substance of the fresh-water sponge is much less dense than that of the sponge of commerce. It is of the softest tissue, and dries to a papery film. These sponge growths are not found in all fresh-water ponds. Where it abounds the water is more or less nauseous and unfit to drink. Being an animal, the sponge gains its sustenance and growth by feeding, and absorbs for its food both microscopic animals and vegetable substances that float in the water. Though in no case, so far as known, poisonous, the sponge is not an edible for any of the higher animals, and neither fish nor water-fowl feed upon it. The formation of the sponge found at Farm Pond was that of a mass of small, finger-like growths, spreading in a branching or bush-like manner from the more compact part, by which it attached itself to whatever fixed and firm substance might lie in the water. These finger-like projections were some of them 3 or 4 in. in length, though most of them were much shorter." Professor Hyatt has seen them of 18 or 20 in. length.

STREETS, DRAINAGE, ETC.

Montreal has appropriated $40,000 for street paving.

The Decatur (Texas) Court-house, valued at $155,000, was burned on the 28th ult.

BLOOMINGTON, Ind., Nov. 21.—A corps of government civil engineer is in this locality surveying the thirty-ninth parallel line across the continent. They say that Bloomington is 800 feet above the sea.

It is reported that Edison is to build 50 miles of experimental electric railway between St. Paul and St. Cloud for the Northern Pacific road. If the engines succeed, Edison will furnish the motive power for the road.

A Youngstown (O.) dispatch, dated Nov. 20, states that the contract for all the unlet work on the Pittsburg, Youngstown & Chicago Railroad, from Newcastle to Pittsburgh, was let on Thursday to one of the heaviest firms in the United States.

Mr. Horace J. Beemer, who has been awarded the contract for the difficult work embraced in the completion of Section 23 and of the Welland canal enlargement, has deposited the necessary 5 per cent with the government. It will amount to something like three-quarters of a million dollars.

The plans for a large freight shed to be erected by the Arrow Shipping Company, of Newcastle-on-Tyne, England, on the new pier, No. 56 North River, have been filed at the Bureau of Inspection of Buildings. The structure will be 75 by 480 ft. in dimensions and will cost $25,000. It will be built of wood and corrugated iron.

A meeting of residents of Washington Heights, Fort Washington and Inwood was held on Thursday night to adopt measures for improving the foot-bridge at 155th street, for hastening the construction of the proposed suspension bridge north of High Bridge, and of a surface railroad on Tenth avenue from Manhattanville to High Bridge and beyond.

BRIDGES.

Bridges are to be built over the Fox River, Ill., at Yorkville and Bristol.

The Erie Railroad Company has spent over $20,000 in strengthening and protecting the mason work of Portage Bridge.

The St. Paul, Minneapolis & Manitoba Railway Company has decided upon the construction of a bridge across the Mississippi at Minneapolis.

An appropriation of $4,500, has lately been made in Binghamton to build a foot bridge at the foot of Exchange st. The work will probably be deferred until spring in hopes of being able to increase the amount.

A dispatch from Ottawa, Canada, states that applications have been made to Parliament for a charter for a drawbridge across the St. Croix River, between New Brunswick and the State of Maine; and also for an act to incorporate "The Niagara Peninsular Bridge Company," to build and work a bridge for railway and other purposes across Niagara River at or near the village of Queenston, with the usual powers.

The Chicago City Council has directed the Commissioner of Public Works to prepare and submit to the Council an estimate for the construction of a bridge at Taylor street. It is proposed to include the amount in the estimate for 1882. The estimated figures are as follows: For substructure, including approaches, engineering, etc., $25,000; wrought-iron bridge, $16,500; dredging, 16,000 cubic yards at 30 cents per yard, $4,800; 21,642 square feet of land to widen the river, at $2.50 per square foot, $54,105; 550 lineal feet of dock at $10 per foot, $5,500—making a total cost of $105,905. The above estimate includes trestlework for approaches, as it is assumed that the railroads will, in the near future, require substantial viaducts over their tracks.

Notice is given that application will be made to the Legislature of the State of New York, at its next session, for an act to incorporate a company with power to construct and maintain a bridge for railroad purposes, over the river St. Lawrence, between the village of Waddington and some point on the Canada shore, to be operated in connection with a railroad to be constructed from Ottawa, Canada, through Waddington, N. Y., to a connection with the Adirondack Railroad, at Canton, N. Y.; said company to be known as the Ottawa, Waddington & New York Railway and Bridge Company.

JAMES REDINGTON,
Attorney for Applicants.

WADDINGTON, Nov. 3, 1881.

The Ottawa *Free Press*, in an article on the Ottawa, Waddington & New York Railway, after quoting from the article published in the *Plaindealer* some weeks ago a paragraph speaking of Ottawa as the great central point of railroad trade for the Dominion, says:

"The O., W. & N. Y. Railway is projected with a view to tapping this great trade, and, being 45 miles shorter from Ottawa to New York than by any other route, it fairly claims the attention of capitalists and business men on both sides of the boundary. The preliminary survey shows exceptional facilities for railway construction, and the site chosen for bridging the St. Lawrence is said to be the best along its course above Montreal. The line has many things to recommend it, and we hope the gentlemen who have taken it in hand will push forward their enterprise, for it is bound to be a success."

RIVERS AND HARBORS.

Canadian engineers take very little stock in Mr. Shearer's plans. There is not overmuch depth of water in Montreal harbor now, and to cut off a portion of the current would lower it too much.

A Montreal dispatch of the 28th ult. says that a party of English engineers were to-day looking into Mr. James Shearer's scheme for a dam and sub-way over the St. Lawrence to St. Helen's Island. They examined the plans, drove to the proposed site of the dam, and had a look into the channel between St. Helen's Island and the south shore. They are highly favorable to the scheme, and pronounce it feasible both from an engineering and financial standpoint. The estimated amount required to build the roadway, etc., is about $4,500,000, and the road duly bonded, and rental accruing from road privileges and water-power rental would in time pay for the whole cost of the undertaking.

RAILROADS.

The track of the Chicago, Texas & Mexican Railroad was completed to Cedar Hill on the 30th ult.

It is generally understood that the Canada Pacific Railway workshops and locomotive works will be placed at Montreal.

A Marshall (Tex.) dispatch says that $300,000 were deposited there last week for the construction of the first 30 miles of the Sabine Pass & Texas Northern Railroad from Marshall southward.

The Means tunnel, on the Elizabethtown, Lexington & Big Sandy Railway, is completed, opening the Chesapeake's all-rail connection via the Kentucky Central to Richmond, Va., and to Newport News, on Deep Water.

Negotiations are in progress with the New York, Lake Erie & Western for the use of the Cincinnati division of the Toledo, Delphos & Burlington as an outlet of business via Dayton. Trains will probably run through from Dayton to Cincinnati within fifteen days.

COLUMBUS, O., Dec. 1.—The Cleveland, Akron & Columbus Railway Company, with $4,000,000 capital, was incorporated to-day by Charles J. Canda, L. A. Russell, George D. Walker, Conrad Halsee and Goshorn A. Jones, who recently purchased the railroad at judicial sale.

The passenger earnings of the Erie road for the last fiscal year amounted to a little more than $4,000,000, an increase of almost $1,000,000 over the year ending Sept. 30, 1879. For this immense gain great credit is due Mr. J. N. Abbott, who has shown himself to be one of the best passenger agents in this country.

The Denver & Rio Grande Railroad Co. has notified the Stock Exchange of an issue of $5,000,000 of its capital stock, the entire amount having been negotiated, we are informed, in London. The issue is intended for the purpose of extending the lines in Colorado, for laying a third rail between Denver and Pueblo, for making the necessary changes in superstructure therefor, and for other improvements.

Louisville and Nashville stock touched par on Wednesday. The road is doing the best business in its history, and the contract reported to have been made by which it allows the Chesapeake and Ohio to come into Louisville over the Lexington branch of the Louisville & Cincinnati Short Line gives the Louisville & Nashville Company the right to regulate the rates from Louisville to the seaboard cities, which will add greatly to the through business of the road.

The Commissioner of the General Land Office denied the application of the Atlantic & Pacific Railroad Company to be allowed to procure government surveys of lands along its line, in New Mexico and Arizona, by means of depositing the estimated cost thereof, under provisions of Sections 2,401-3, Revised Statutes. Commissioner McFarland holds the privilege accorded by those sections is confined to settlers residing in townships to be surveyed, and that corporations are not "settlers" within the meaning of the statutes.

"The Steel Association of Ontario" is the name of a recent applicant for letters-patent, the hadquarters to be in Belleville, Ontario, capital to be $700,000 in shares of $50 each. The promoters are chiefly from Buffalo and Cincinnati. The object of the company is the seeking for acquiring and working iron mines in Ontario, the purchase of iron ore, the establishment of smelting works and works for the production of steel under such processes and patents as the company may acquire or have the right to use; also for the purpose of manufacturing articles from steel and also from iron, and for the sale of all the said products; also for the purpose of buying, importing and selling coal.

All the rolling-mills for iron and steel rails have contracts ahead to an extent that will require their utmost power of production for several months running. As a consequence, prices have materially advanced. From present indications, based upon actual contracts made for future delivery of all kinds of railroad supplies, there may be more miles of railroad constructed in 1882 than during the year now drawing to a close, which will show more miles of new railroad constructed than before since 1871. The Union Pacific road needs many new locomotives at once, and can make contracts for delivery no earlier than in 1883.

COST OF RUNNING TRAINS.—The annual report of the working of English railways gives the following items in regard to cost per train mile of all trains run in 1880, as compared with the year before. The figures given are reduced to cents in American money:

Account.	1880.	1879.
Maintenance of way	11.55	12.12
Locomotive power	15.45	15.56
Rolling stock	5.76	5.52
Traffic expenses	19.19	19.78
General charges	2.72	2.77
Rates and taxes	2.98	3 09
Government duty	1.48	1.52
Personal injuries	0.44	0.42
Damage to goods	0.34	0.38
Legal and parliamentary	0.53	0.44
Miscellaneous	1.14	1.14
Total	61.58	62.74

The Supervisors of Tioga County, N. Y., are contemplating building a new jail and residence for the Sheriff in connection with it, to be located at Owego. Plans will be submitted shortly. The Owego *Times* of the 24th inst. says: "We are pleased to learn that the Supervisors generally are in favor of a new jail. The old site is likely to be chosen; indeed, it could not be bettered. It is central, yet sufficiently secluded, and the county possesses enough land for all purposes. The material of which the structure will be built is not, as yet, decided upon, nor has the plan, as yet, been definitely fixed upon. The principal difficulty with the present shell is partly in the material, partly in the want of ventilation, but specially in the total want of sewerage. It is impossible to keep it smelling properly. But now that we have got water, a good sewer should be constructed into the Susquehanna River at or near the bridge. The parties owning property along this route would gladly bear their part in the expenses of such a public convenience."

On the 23d ult. the Texas Southern Trunk Line Railroad Company and Telegraph and Express Company filed articles of incorporation at the office of the Secretary of State of Texas. The scheme comprises a system of local connections, embracing in all something in the neighborhood of 1,800 miles of railroad of narrow gauge. It is designed to control the trade of the State in the direction of Texas gulf ports. The following extract from the charter shows the route: "The place from which said Texas Southern Trunk Line Railroad Company and Telegraph and Express Company shall be constructed and operated is Galveston, in Galveston County, and Houston, in Harris County, and running through Montgomery and Grimes counties, to or near Madisonville, in Madison County; to or near Centerville, in Leon County; to or near Fairfield, in Freestone County; to or near Corsicana, in Navarro County; to or near Waxahachie, in Ellis County; to Fort Worth, in Tarrant County; through Parker County, Wise County, Jack County; to and through Clay County; to or near San Thomas, in Archer County, with a branch from or near Centerville, in Leon County; to or near Groesbeeck, in Limestone County; to or near Waco, in McLennan County; to or near Meridian, in Bosque County; to or near Stevenville, in Erath County; to Eastland, in Eastland County; to or near Breckenridge, in Stevens County; to or near Camp Cooper, in Throckmorton County, with a branch from Corsicana, in Navarro County; to or near Kaufman, in Kaufman County, to Greenville, in Hunt county; to or near Cooper, in Delta County; to Paris, in Lamar County; also a branch from Greenville, in Hunt County, to Bonham, in Fannin County, and a branch from or near Waxahachie, in Ellis County, to Dallas, in Dallas County; also a branch from Aurora, in Wise County, to or near Denton, in Denton County, and with branches from or near Denton to Sherman, in Grayson County, and Gainesville, in Cooke County; also a branch from the main line, in Montgomery County, through Liberty and Polk counties, to or near Woodville, in Tyler County; also a branch from the main line, in Montgomery County, to or near Hempstead, in Waller County, through Austin County; to or near La Grange, in Fayette County; to or near Bastrop, in Bastrop County; through Travis County, to the intersection of the Austin & Northwestern Railroad, at or near Round Rock, in Williamson County; to or near Georgetown, in Williamson County; to or near Belton, in Bell County; to Waco, in McLennan County; also a branch from or near Bastrop, in Bastrop County; to or near Lockhart, in Caldwell County; to or near San Marcos, in Hays County; also a branch from or near Lockhart, Caldwell County; to or near New Braunfels, in Comal County; to or near San Antonio, in Bexar County; to or near Boerne, in Kendall County; to or near Kerrville, in Kerr County; with a branch from or near Boerne, in Kendall County, to or near Fredericksburg, in Gillespie County, and Mason, in Mason County, at the intersection of the Austin & Northwestern Railroad. The main line and branches to be constructed along the most practical and expedient route in the counties aforesaid." The principal business office shall be established in Houston, with branch offices in Galveston and Austin. The capital stock is $15,000,000, at $100 per share.

NEW PROJECTS.

The Painesville Water and Steam Heating Co., of Painesville, O.; capital $200,000.

The Edison Company for Isolated Lighting, with a capital of $500,000, has filed articles of incorporation in Albany.

The articles of incorporation have been filed in Albany of the Santa Martha Railroad Company, with a capital of $2,500,000; the road to be built in the United States of Colombia.

Fort Hope intends making application to the Ontario Legislature for power to make an additional issue of debentures for the purpose of encouraging the establishment of new manufactories, and for the further extension of the water-works.

The Millbank, Kibby & Tower City Railroad Company has been organized in Dakota; capital $200,000. The company proposes to build a railroad from Tower City to Millbank, where a junction will be made with the Chicago, Milwaukee & St. Paul Railway.

A charter has been granted to the Ohio River & Lake Erie Railroad Company, which proposes to build a line from the vicinity of Sharpsville, Mercer County, to Girard, Erie County. It is to be 60 miles in length. The capital stock is $3,000,000.

The Middletown, Lebanon & Cincinnati Railroad Company, capital $100,000, has been incorporated by H. P. Clough, C. H. Wardlow, D. L. Brisch, John Cunningham and C. F. Gunckel, with offices at Middletown, and passing through the counties of Butler and Warren. It is understood that this is to be a local line between Middletown and Lebanon.

The Guideau Springs Railroad Company have filed their charter with the Secretary of State of Kansas. The company propose to build a road from Arkansas City, Cowley County, Kan., by way of Mineral Springs, to Dodge City, Kan. The length of the line will be about 200 miles. The capital stock is $200,000. Guideau Springs will be the headquarters of the road.

The Chicago, Missouri & Kansas Railroad Company has filed articles of incorporation in Topeka, Kan. The road is to run from a point on the Missouri River, in the County of Saline, Mo., to the west line of the State of Kansas, with a branch to Dodge City, the estimated length to be 600 miles. The company's headquarters will be at Oswego, Kan. The capital stock of the company is $15,000,000. The Directors are: A. A. Harris, Fort Scott, B. F. Hobart, C. M. Condon, F. A. Bitters and C. B. Sperry, of Oswego.

CONTRACTING, MISCELLANEOUS, ETC.

Plans are now being drafted for the Central Building of the Topeka, Kan., State House.

The time for receiving bids for the Austin, Texas, new capitol has been extended to Jan. 1 next. Chicago parties are in the field bidding for the work.

The Bryan (Texas) County commissioners have decided to build a bridge over the Wavasola River, to improve the public highways, and to build a new poor-house.

The Finance Committee of the Indianapolis, Ind., council reported the city treasury bankrupted, and that a loan of $70,000 was necessary to tide over the next four months.

The contract for the branch of seven miles to connect the Toronto & Nipissing and the Whitby, Port Perry & Lindsay, has been let to Geo. Wheeler, M. P. The work is to be completed by the 1st of September, 1882.

Contracts for all the grading on the Gulf, Colorado & Santa Fe Railroad between Lampasas and Copperas Cave, Texas, are now let. Jones & Cleod, Richer & Evans, have the contract for the first ten miles.

The city of Binghamton has just appropriated $4,800 for the purchase of a site on Canal street known as the Paige property, to erect a military armory and store house, to be used by the 20th separate company, N. Y. S. N. G., of that city.

The Dominion Government expect that the Canada Pacific Railway will be completed in 1890, at which time it is expected there will be a sufficient surplus of funds on hand to discharge the government's obligations on the road.

The New York, Indiana & Western Construction Company, capital $1,500,000, with the object of furnishing material to build railroads, has been incorporated at Indianapolis. A. J. Hodder, James T. Brady and F. V. Perrin, of New York, are directors.

A massive marine railway, 650 feet long and 50 feet wide, and capacle of hauling out a 1,500-ton vessel, has just been completed at Fair Haven, Conn. It is to be put up at Campeachy City, Mexico, and the cost of its construction and erection there will be nearly $50,000.

The enterprising firm of Brentnall & McDonald, of Bath, N. Y., have large contracts for masonry on the line of the New York, Lackawanna & Western Railroad. The new bridge masonry over the Chenango River at Binghamton, and the masonry at Sarona and Liberty, was constructed by this firm.

A contractor who has a claim of $150,000 proved up against the Indiana, Bloomington & Western Railroad, for grading and tying the line from Clinton to Havana, has for some time past been working in a lumber yard at Champaign at $40 a month. He wrecked a comfortable fortune in executing the contract.—*Chicago Times.*

Sturgeon Bay Canal (Wis.) is finished. Cost, $700,000. Mr. Jesse Spalding is President; Gen. W. E. Strong, Vice-President and Treasurer of the Canal Company; O. B. Green is the contractor, and W. F. Casgrain is the chief engineer. The company expect that the canal will afford an avenue for the passage of vessels aggregating one million tonnage annually hereafter.

PANAMA, Nov. 16.—Canal work along the line appears to have been suspended since the death of Mr. Blanchet. Surveys are progressing. Mr. Hersent, of the contracting firm of Couvreux & Hersent, and Mr. Dauzats, chief engineer of the Suez Canal, are on the way to the isthmus to put the work in shape and complete the organization begun by Mr. Blanchet, which, it is understood, was generally approved by the consulting engineers and others in Paris.

Some five hundred 640-acre land certificates, in the hands of the surveyor of Pecos county, Texas, were sequestered at Austin on the 19th inst. by Mr. R. Thomson, land agent. The certificates, which were issued to the Gulf, Colorado & Santa Fe Railway Company, were located in the Pecos land district, and Mr. Thomson claims that the surveyor's charges for survey and locating fees are about $6,000 more than the law allows. The certificates cover, for owners and the school fund, 640,000 acres of land.

The Wyoming County (N. Y.) quicksands are a source of great annoyance in the construction of any public works. In order to lessen a grade between Portage Bridge and Castile, the Erie has put in a loop line. This line makes a detour through a hill of quicksand and over a deep ravine. At the bottom of the ravine is a culvert built upon pile foundations, and extending down to the rock. The superincumbent weight of rock upon this treacherous mass of earth has caused the whole to sink, while the lower material is making preparations to move down the ravine. Already large forest trees have been carried downward toward the river bank, and fears are entertained that the whole embankment will slide out of position. The track repairers, who have raised the bank three times within as many months, now have substituted a short tangent to accommodate the running of trains. The culvert in the new road-bed has become to some extent demoralised, and information is now wanted how to hold the track to its original survey.—*Exchange.*